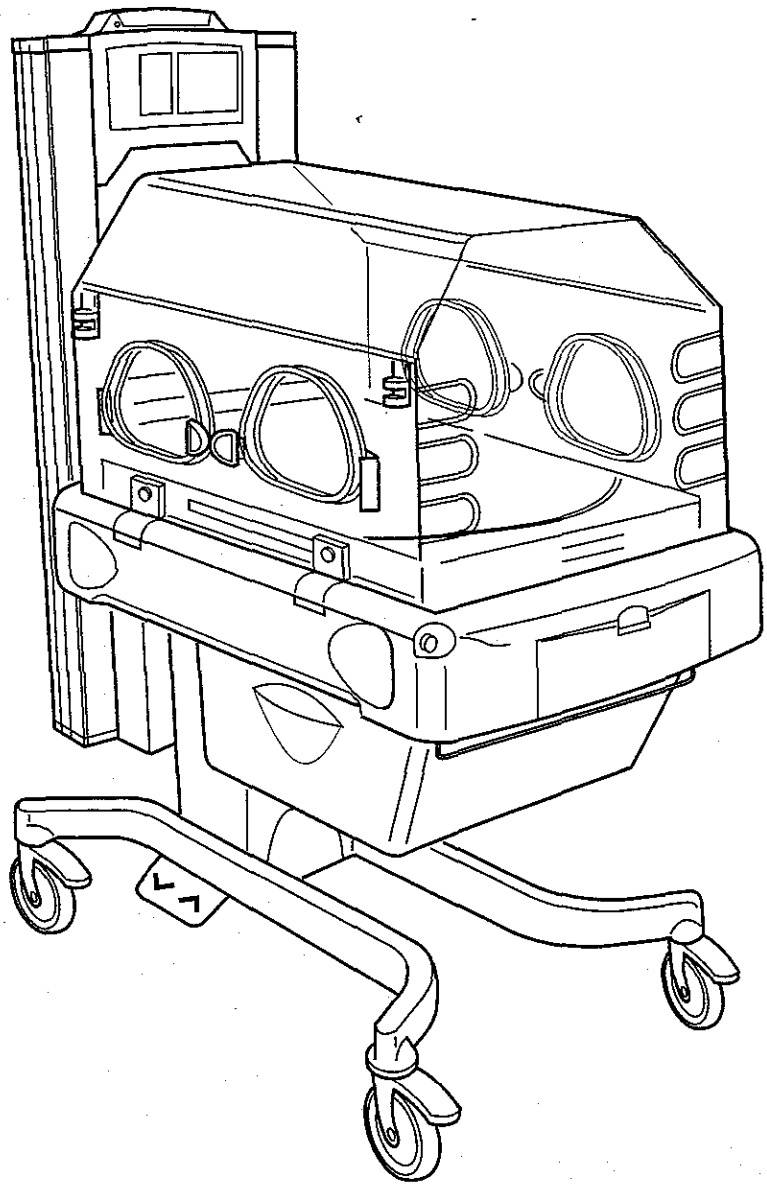
OHMEDA
Medical

Giraffe™ Incubator

Service Manual



Important

The information contained in this service manual pertains only to those models of products which are marketed by Ohmeda Medical as of the effective date of this manual or the latest revision thereof. This service manual was prepared for exclusive use by Ohmeda Medical service personnel in light of their training and experience as well as the availability to them of parts, proper tools and test equipment. Consequently, Ohmeda Medical provides this service manual to its customers purely as a business convenience and for the customer's general information only without warranty of the results with respect to any application of such information. Furthermore, because of the wide variety of circumstances under which maintenance and repair activities may be performed and the unique nature of each individual's own experience, capacity, and qualifications, the fact that a customer has received such information from Ohmeda Medical does not imply in anyway that Ohmeda Medical deems said individual to be qualified to perform any such maintenance or repair service. Moreover, it should not be assumed that every acceptable test and safety procedure or method, precaution, tool, equipment or device is referred to within, or that abnormal or unusual circumstances, may not warrant or suggest different or additional procedures or requirements.

This manual is subject to periodic review, update and revision. Customers are cautioned to obtain and consult the latest revision before undertaking any service of the equipment.

CAUTION ⚠ Servicing of this product in accordance with this service manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision to this service manual which is clearly and thoroughly understood.

This static control precaution symbol appears throughout this manual. When this symbol appears next to a procedure in this manual, static control precautions MUST be observed. Use the static control work station (Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices.

Technical Competence

The procedures described in this service manual should be performed by trained and authorized personnel only. Maintenance should only be undertaken by competent individuals who have a general knowledge of and experience with devices of this nature. No repairs should ever be undertaken or attempted by anyone not having such qualifications. Genuine replacement parts manufactured or sold by Ohmeda must be used for all repairs. Read completely through each step in every procedure before starting the procedure; any exceptions may result in a failure to properly and safely complete the attempted procedure.

Definitions

Note: A note provides additional information to clarify a point in the text.

Important: An Important statement is similar to a note, but is used for greater emphasis.

CAUTION: A CAUTION statement is used when the possibility of damage to the equipment exists.

WARNING: A WARNING statement is used when the possibility of injury to the patient or the operator exists.

Type B Electrical equipment

Protective ground

Functional Ground

~ Alternating Current (AC)

Static Control Precaution

European Union Representative

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⚠Warnings

Before using the Giraffe Incubator, read through the entire operator's manual. As with all medical equipment, attempting to use this device without a thorough understanding of its operation may result in patient or user injury. This device should only be operated by personnel trained in its operation under the direction of qualified medical personnel familiar with the risks and benefits of this type of device. **Additional precautions specific to certain procedures are found in the text of this manual.**

Complete the "Pre-operative Checkout Procedures" section of the Operator's manual before putting the unit into operation. If the incubator fails any portion of the checkout procedure it must be removed from use and repaired.

Do not use the incubator in the presence of flammable anesthetics; an explosion hazard exists under these conditions.

Always disconnect the power before performing service or maintenance procedures detailed in this manual. Apply power only if you are specifically instructed to do so as part of the procedure.

Thoroughly air dry the incubator after cleaning it with flammable agents. Small amounts of flammable agents, such as ether, alcohol or similar cleaning solvents left in the incubator can cause a fire.

⚠Cautions

Only competent individuals trained in the repair of this equipment should attempt to service it as detailed in this manual.

Detailed information for more extensive repairs is included in the service manual solely for the convenience of users having proper knowledge, tools and test equipment, and for service representatives trained by Ohmeda Medical.

This functional description is divided into four sections representing each of the four boards. The reader should also reference the block diagram and wiring diagram when studying this section.

1.1 Control Board

The Intel 80C188EC microcontroller is an enhanced X86 processor with many on-board peripheral features, such as a interrupt controller, DMA controller, peripheral chip select driver, programmable timers, etc. A programmable timer is used to control the heaters. The input to this timer is line frequency. This allows the control signal to be synchronized with the line frequency to better control the zero-crossing solid state relays. The on-board interrupt controller has several interrupts: analog-to-digital converter (ADC) conversion ready signal, overtemperature comparator output, watchdog output, power fail signal, and module interrupt signal from the system data bus. The microcontroller external bus is a multiplexed address and data bus.

The system memory consists of a programmable read-only memory (PROM) and static random access memory (SRAM). The EEPROM is used for calibration values and infrequently changing variables. This memory holds the data even after power is turned off.

The RS-485 integrated circuit converts the RS-232 TTL signals from the microcontroller to RS-485 signals for the bus. This bus is the main communications bus from the control board to all other boards with processors.

There are two isolation transceivers used to isolate the circuits powered by +5V and the circuits powered by +5VSTBY (battery backup).

The board contains a 16 channel multiplexer. There are seven temperature measurement channels. These channels measure the two patient probes with two thermistors each, the two air temperature thermistors used for display and control, and an additional thermistor used to measure the heat sink temperature. Additional channels include the humidity sensor (RHIN), LINE COMP, 5 Volts, Motor current, Vthref, VDAC, and 1.2Vind.

Attached to the environmental probe connection is the relative humidity signal conditioning circuitry. The 1V reference that is used for the analog circuitry is also the maximum input voltage and the offset voltage for the ADC. This yields a purely ratiometric system.

The overtemperature circuit compares the air temperature to a reference level, generates an interrupt, and turns off the heat if the air temperature is higher than the reference level. Since the thermistor measurements are digitally calibrated, the circuit must allow for various voltage levels for overtemperature thresholds.

The watchdog function is housed in a RISC processor. The watchdog circuitry is independent of the 80C188 controller. The audio function is also programmed into the RISC processor. The audio circuit includes a 8752 microcontroller that reads a wavetable located in a PROM and sends the table to a digital audio circuit and amplifier. The high priority (HP) and other alarm signal lines select an output at the correct frequencies. Three OR gates are combined to generate the error signal. The inputs to the circuit are overtemperature, power failure, and system failure. This circuit generates an error signal that turns off the heater and sounds the HP alarm. This circuit is independent of the microcontroller.

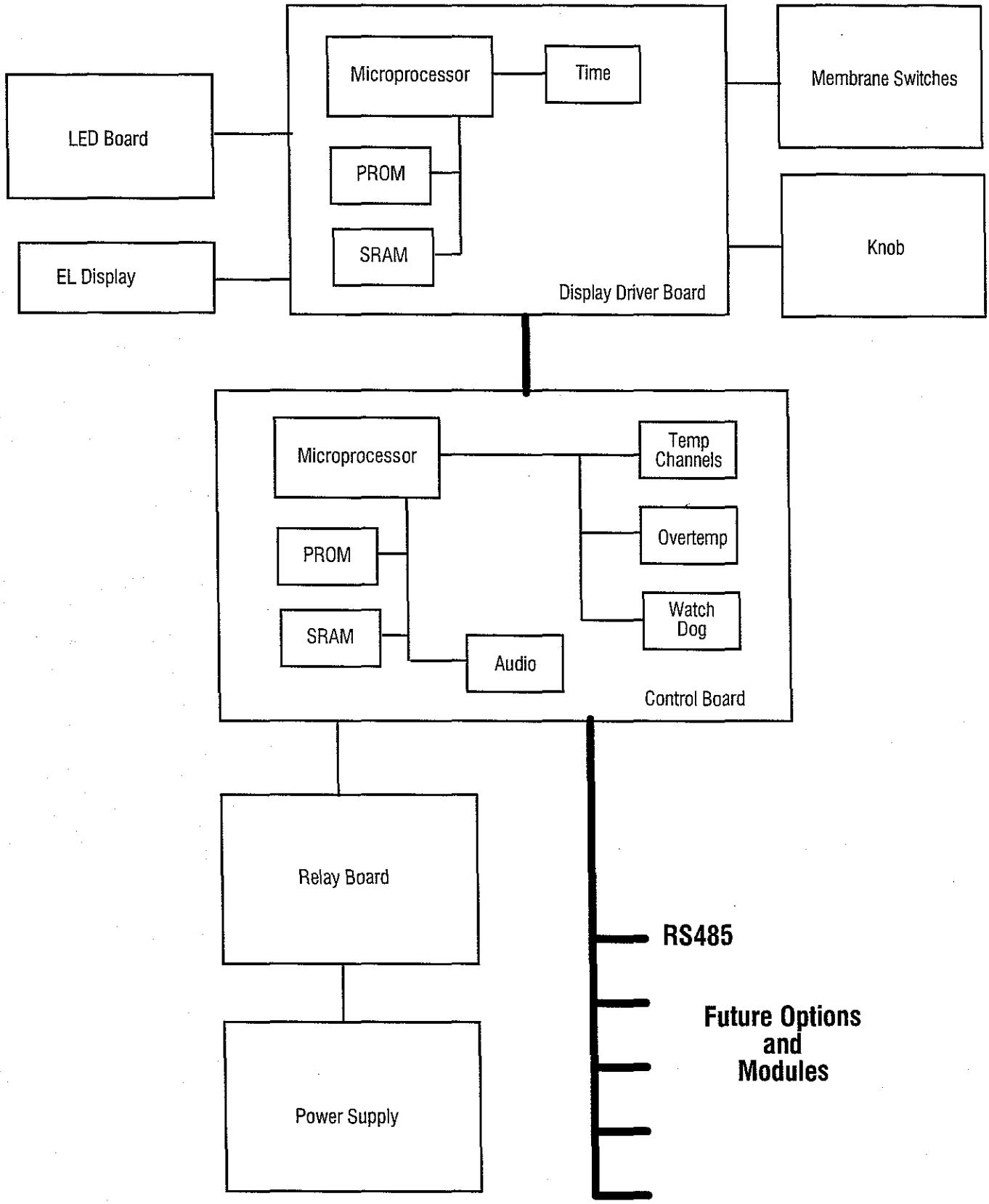


Figure 1-1
Block Diagram

1.2 Relay Board

The relay board contains the circuitry to drive the two solid state relays and the safety relay circuits. The control signal for these functions is generated on the Control Board.

There is a current sense circuit for the bed heater and an additional one for the humidifier heater. These circuits consist of a small signal transformer that produces a current proportional to the current through the heater circuits. The current is rectified and measured. The subsequent comparator then generates a digital level based on a specified current level. This results in a signal representing the state of the heater (on or off).

The line compensation circuit consists of a signal transformer connected to the mains voltage. The secondary of this transformer feeds a full wave rectifier and a capacitor. The resulting DC voltage is proportional to mains voltage, and is measured on the control board.

The line frequency circuit consists of a half wave rectifier and a comparator. This circuit generates a digital pulse synchronized with the line frequency (50 or 60 Hz).

The battery backup circuitry is connected to the +12V line. The 5V regulator generates the +5V standby from either the +12V or the battery voltage, whichever is larger. If there is no mains power, 12 volts is not present, and the battery will generate the +5V standby. When 12V is present, the battery is biased out of the circuit with the diode and is merely being trickle charged.

The motor driver circuit turns the DC motor coils in the incubator fan motor on and off based on feedback from the hall effect position sensors. This integrated circuit can also vary the speed and brake the motor based on input signals from the control board.

The elevating base circuit consists of a series of relays that apply voltage to the elevating base motor. The e-base motor is always driven at 24-32 volts.

The airflow sensor consists of an opto-coupler that outputs a clocking pulse proportional to the fan movement. The signal is AC coupled to eliminate offset voltages and drifts. The resulting pulse is half wave rectified and stored in a capacitor to yield a DC voltage proportional to the fan speed. If the fan stops or there is no fan, this DC voltage becomes zero.

1.3 Display Driver Board / EL Display

The Display Driver board contains the same Intel microcontroller as the Control board. The processor on the display board is used to control the EL display contents and monitor user inputs received from the membrane switch panel and rotary encoder knob.
There are two groups of digital inputs: membrane switch panel and rotary encoder knob. The membrane switches are pulled high; pressing the switch grounds the input. The encoder also has a switch, and two optically isolated lines that pulse out of phase with each other. The number of pulses represents the number of steps the knob rotates. The phase of the pulses represents the direction of the knob rotation.

The display board system memory consists of a programmable read-only memory (PROM) and static random access memory (SRAM).

The RS-485 integrated circuit converts the RS-232 TTL signals from the microcontroller to RS-485 signals for the bus.

The timekeeping RAM has a battery integrated into the chip so that the time and date are kept current even with the power off. The battery has a minimum life of 10 years.

The graphics controller is an S-MOS VGA controller. The graphics controller interfaces the data from the video RAM to the EL display. The controller also synchronizes the display using a horizontal pulse (LP) and a vertical pulse for the whole display frame (YD). The controller handshakes with the 80C188 using the READY line to eliminate any lost data during display refreshes.

1.4 LED Board

The LED Board contains five display banks and two display drivers. One of the display drivers controls the patient temperature and air temperature display banks. The other driver controls the patient set temperature, air set temperature, and the mode and override indicators.

This allows the two large displays (patient and air temperature) to be multiplexed at a slower rate than the other LEDs. This results in brighter large displays. Each driver has a brightness potentiometer that is preset at the factory and should not be adjusted in the field.

1.5 Power Supply

The universal input switching power supply converts the line voltage to +5V DC and +12V DC. This supply can source up to 75 watts. The 5 volts powers the electronics and the 12 volts is used by the EL display and for future boards.

1.6 Peripheral Components

There are several peripheral components.

The toroidal transformer bucks the line voltage to the range of the elevating base system.

The solid state relay mounted inside the electronics enclosure is used to control the bed heaters.

WARNINGS ⚠ **Do not perform the preoperative checkout procedure while the patient occupies the unit.**

⚠ **Complete the preoperative checkout procedure section of this manual before putting the unit into operation. If the equipment fails any portion of the checkout procedure it must be removed from use and repaired.**

2.1 Mechanical checks

1. Disconnect the power cord for the mechanical portion of the preoperative checkout procedure.
2. Examine the power cord for any signs of damage. Replace the cord if damage is evident.
3. Check that both plug retaining brackets are in place.
4. Examine the unit overall for any damaged or missing parts.
5. Check that all the casters are in firm contact with the floor and that the unit is stable. Lock the caster brakes and check that they hold the unit in place. Release the brakes and check that the unit moves smoothly.
6. Check the operation of the side doors. Open the doors and check that they swing all the way down and hang perpendicular to the bed. Check that the doors are securely attached to the unit and that the hinge pins are properly seated. Check that the inner walls are securely fastened to the doors. Close the doors and check that the latches hold the doors securely shut. The orange latch open indicators should not be visible when the latches are engaged. Check that the hood is in the locked position.
7. Check the tubing acces door at the top of the ventilator slot in the back wall. It should flip up easily and smoothly, and stay in position anywhere on its travel path.
8. Check the portholes. Open the portholes by pressing on the latch. The cover should swing open. Close the porthole and check that the latch holds the cover securely shut and that the cover seals tightly against the porthole gasket. Check that all the porthole seals are in place and are in good condition.
9. If the unit is equipped with an iris porthole, check the iris is installed and in good condition. Check that the iris tightens when it is rotated.
10. Check that the tubing access covers in the four bed corners and the large slot grommet at the head of the bed are in place and are in good condition.
11. Check the operation of the bed. The bed should rotate easily without binding. If the bed is properly seated and locked in place, the mattress should be level. With the bed rotated back into the straight position, check to see that the bed platform extends and stops when it is pulled out on either side. Check the operation of the bed tilt mechanism. Squeeze the tilt control and push down on the foot of the bed. The head of the bed should raise easily, and should stay in position at any angle along its tilt path when the tilt control is released. Push down on the head of the bed. The foot of the bed should raise easily, and should stay in position at any angle along its tilt path when you the tilt control is released.
12. Check the operation of the hood lock. Release the lock and raise the hood. Make sure it locks in the open position. Release the lock and lower the hood. Make sure it locks in the closed position.

2.2 Controller checks

WARNING ⚠ **Do not use the Incubator in the presence of flammable anesthetics: an explosion hazard exists under these conditions.**

1. Connect the incubator power cord to a properly rated outlet .
2. Connect the patient probe to jack 1 on the probe panel.
3. Switch on the power at the mains switch on the back of the unit, and at the standby switch on the jack panel, while holding in the override button (>37) on the display during power up until the software revision screen appears. Release the button and the first service screen will appear.
4. Scroll to "Down" and select it to bring up the second service screen. Select Status to see Status screen. Check status of the software self tests. These include: heater on (INCHTRON),) heater off (IHTROFF), humidifier heater on (RHHTR), remote monitoring data stream (RS232LOOP), incubator fan on (FANON), and incubator fan off (FANOFF). All test should say PASS except RS232 LOOP. If the RS232 option is not installed RS232LOOP will display N/A. To test the circuit if the option is installed, short pins 2 & 3 on the 9 pin connector on the back of the electrical enclosure.
5. Using the standby switch turn off the unit, then turn it back on.

   Verify the following:
   - All the displays and indicators light
   - The software revision appears
   - The prompt tone begins

   Note: If the unit has been used in the last 2 hours, the patient history query appears.
6. Adjust the set temperature to silence the prompt tone.
7. Check the patient probe. If the probe is below 30 C, the display will show -L-. Warm it by placing it between your fingers, and verify that the baby temperature reading increases.
8. Unplug the patient probe and check that both visual and audio alarms trigger in the Baby control mode.
9. If so equipped, check the operation of the bed elevating system. Raise and lower the bed along its entire travel range, checking that the mechanism operates smoothly. Check that the pedals on both sides of the unit raise and lower the bed.
10. Check the power failure alarm and the battery backed up memory. Make note of the current control mode and temperature settings and wait one minute, then unplug the Incubator from the wall outlet. An alarm should sound and the power failure indicator should light. Wait one to two minutes and plug the Incubator back in. Verify that the alarm cancels and that the Incubator returns to the same control mode and temperature settings it displayed before the power interruption.

    Note: A fully charged battery should supply the power failure alarm for approximately 10 minutes. If the alarm is tested for the full 10 minutes the Incubator must be run at least two hours to recharge the battery before it is used with a patient. Total recharge time is 8 to 10 hours.
12. Perform the Leakage Current and Ground Resistance checks in Chapter 3 of this manual.

2.3 Accessory checks

1. Check that all accessories are securely mounted and out of the path of the hood in the open position.
2. Check the operation of any accessories with reference to their appropriate operation manuals.
3. Setup any required suction or gas supply systems. Check them for leaks as described in their respective operation manuals.

2.5 Cable Connections and Mechanical Controls

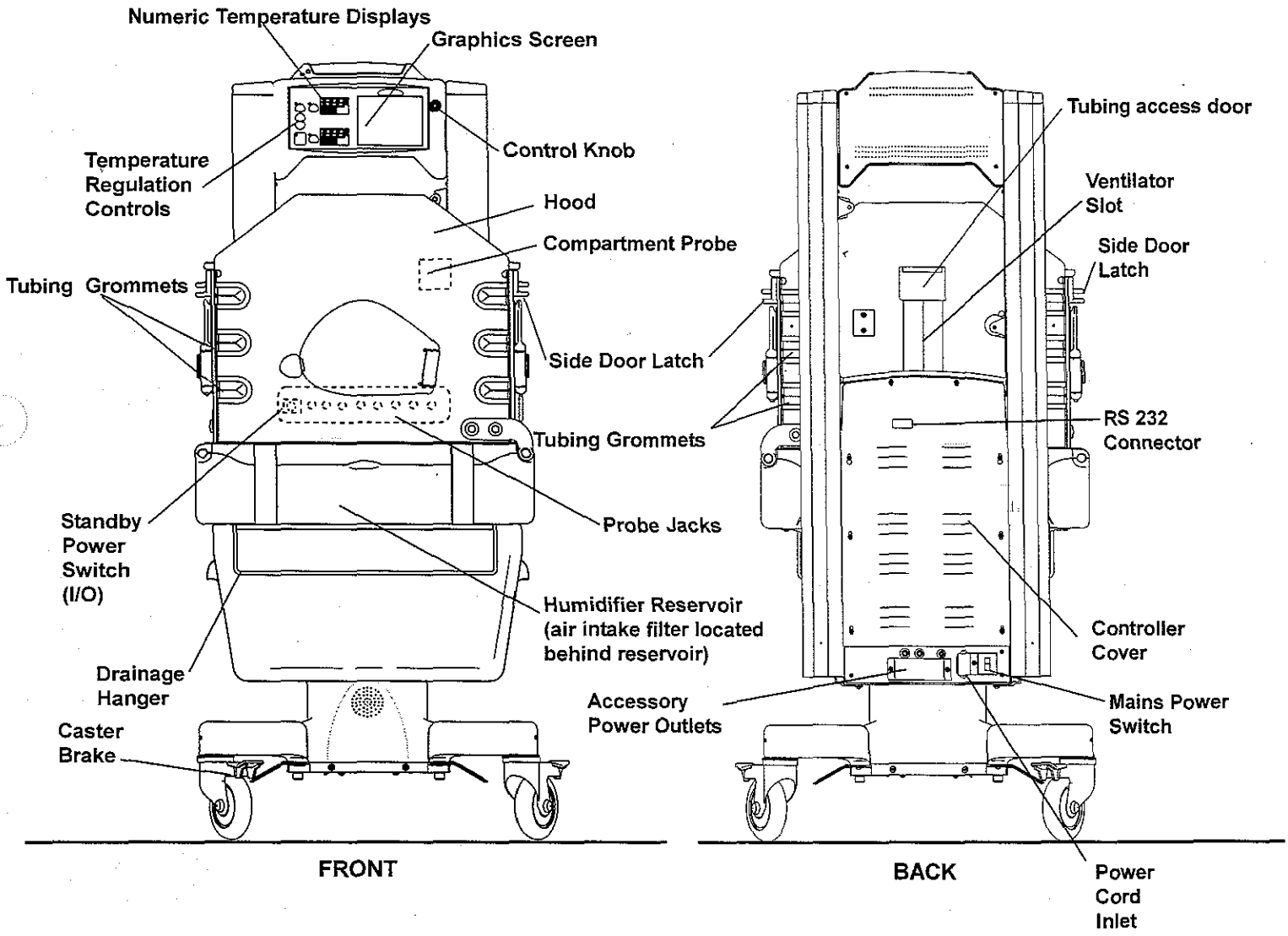
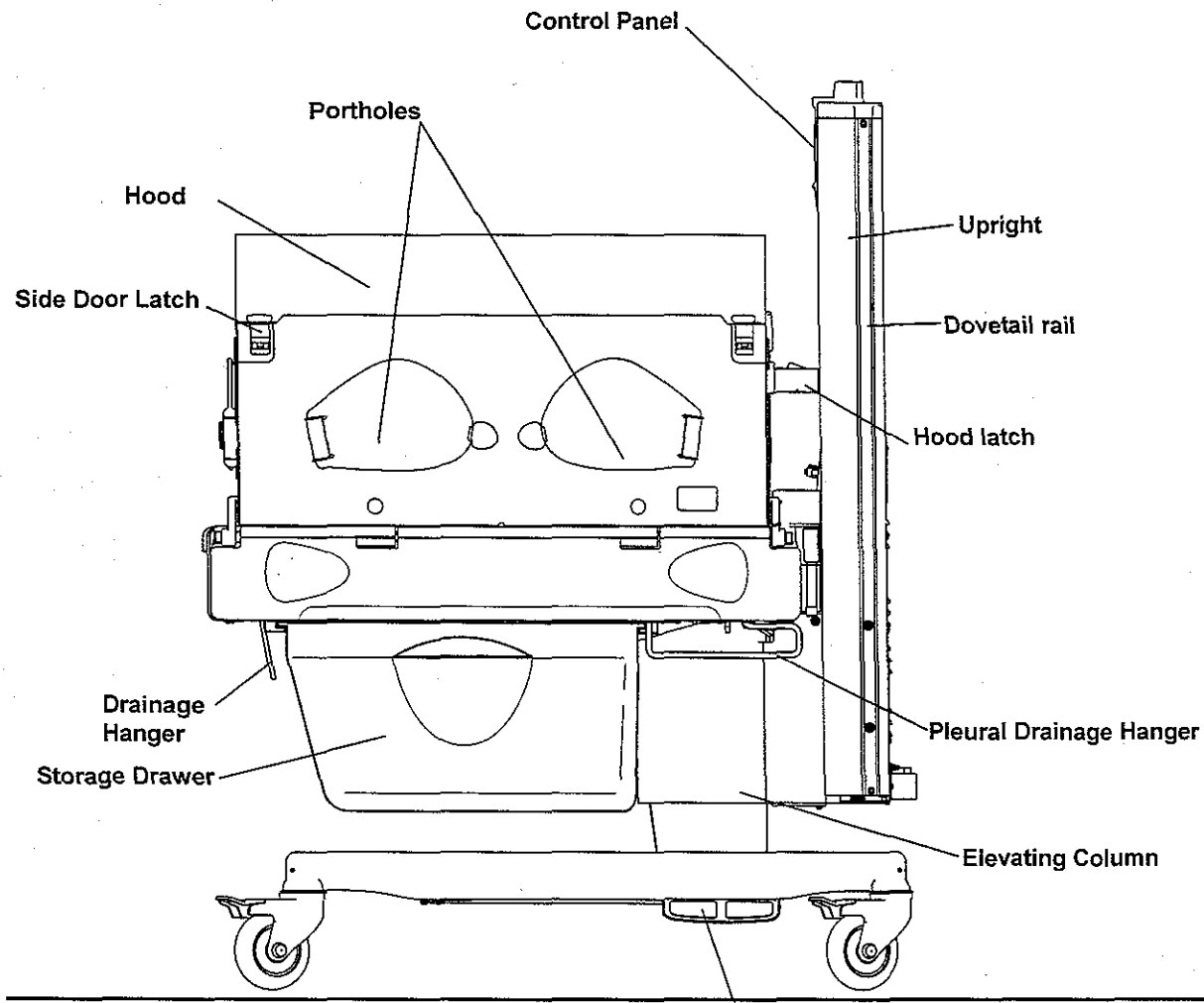


Figure 2-1
Connections and controls


Control Panel
Portholes
Hood
Upright
Side Door Latch
Dovetail rail
Hood latch
Drainage Hanger
Pleural Drainage Hanger
Storage Drawer
Elevating Column
Bed Height Pedal

SIDE

Use Static Control Work Station to help ensure static charges are safely conducted to ground. The velostat material is conductive; do not place electrically powered boards on it. Whenever this symbol appears beside a procedure, take static control precautions.

WARNING ⚠ After performing any repair or calibration, always perform the Service Checkout Procedure before putting the unit back into service.

3.1 Maintenance schedule

The unit should be maintained in accordance with the procedures detailed in this manual. Service maintenance must be performed by a technically competent individual.

Service maintenance

This schedule lists the minimum frequencies. Always follow hospital and local regulations for required frequencies.

Annually

Perform the electrical safety and calibration procedure as described in the service manual.

Calibrate the scale.

Every Two Years

Replace the battery.

Note: The battery is used to sound the power failure alarm and to power memory circuits during a power failure.

Every Three Years

Calibrate the humidifier.

3.2 Special Tools

The following tools (or their functional equivalents) are required to complete the recommended service procedures:

Digital Multimeter, 4-1/2 digit
Leakage Current Tester
Static Control Work Station (recommended)
Light gray touch-up paint (Munsell .16GY8.56-0.44 chroma)-18ml 6600-0714-200
Servo Humidity Calibration Kit 6600-0048-850
Scale calibration weight- 5kg 6600-0209-800

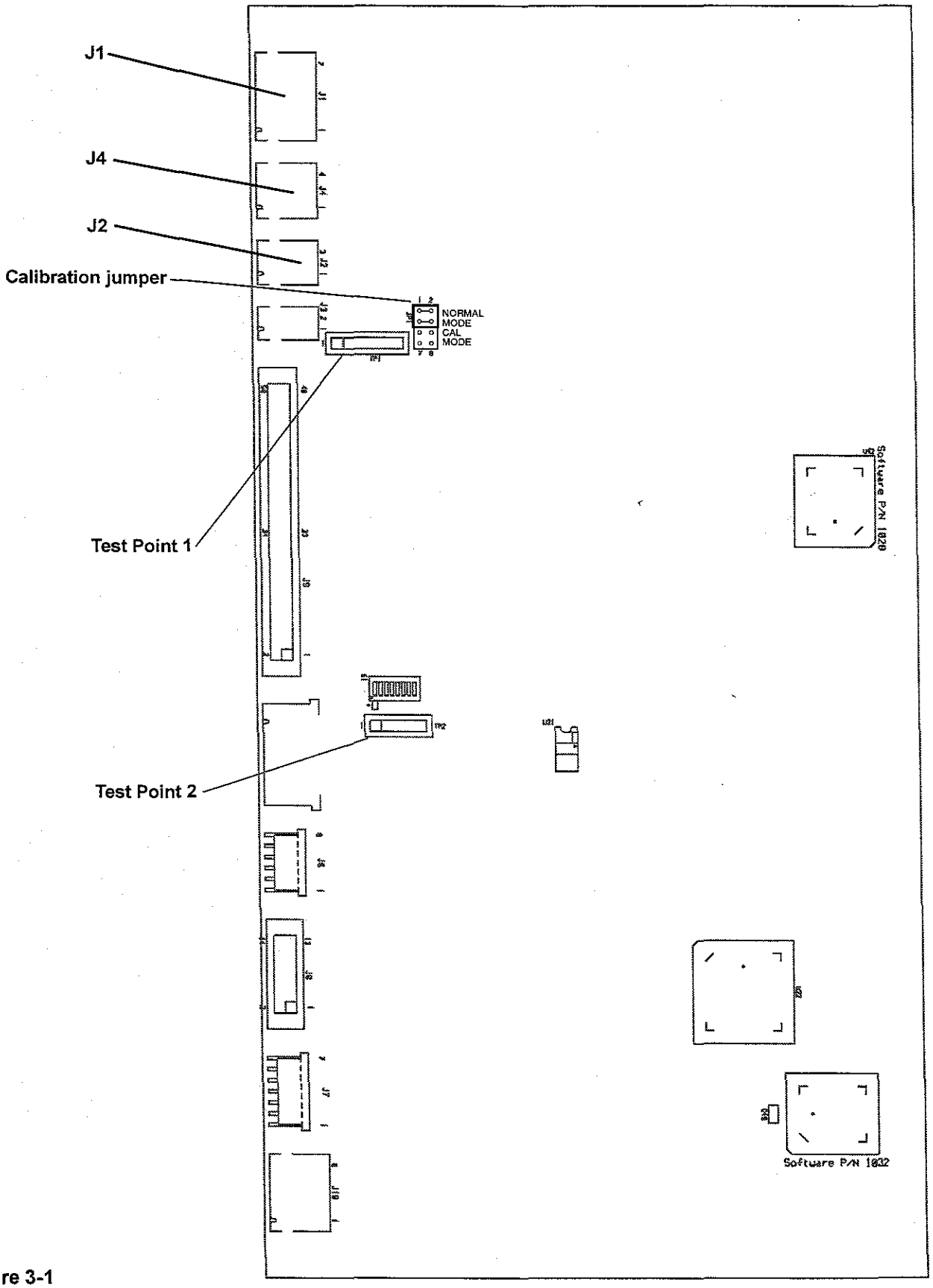


Figure 3-1
Control board test points

3.3 System Calibration

Note: If Only performing line voltage calibration, follow instuctions in next section, 3.4.

Important: Be sure to perform System Calibration after replacing a control board.

1. Turn power off.
2. Remove electrical enclosure back panel.
3. Unplug the temperature sensors from J1, J4 and J2 on the control board.
4. Move jumper JP1 to the CAL MODE position on the control board (see Figure 3-1 on next page). Be sure to orient the jumper correctly so pins 5-6 and 7-8 are shorted.
5. Turn power on. After running the power-up testing INITIALIZING will be displayed and dots will move across the top of the screen.
6. After about 90 seconds CALIBRATION MODE, Enter "VREF", and Enter "Mains" will be displayed.
7. Using a 4 ½ digit DVM (capable of measuring to 0.1 millivolt) measure VREF at TP1, pins 1 and 6 (pin 6 is ground) on the control board. Measure to the nearest 0.1 millivolt.
8. Dial in VREF using the control knob. Press the knob to enter the value.
9. Measure the Mains Voltage at the AC connectors at the bottom of the electronics enclosure cover.
10. Dial in the Mains voltage using the control knob. Press the knob to enter the value.
11. After a few seconds the dots will stop moving across the screen and DONE will appear on the top right of the display. Do not shut off the unit until the DONE message is displayed or the new calibration values will not be stored.

    If the message "Mains voltage calibration failed. Please enter the mains voltage again" appears this indicates the dialed in line voltage is 20% different than the measured value (not the nominal value).

12. Power down the unit and move the calibrate jumper to the NORMAL MODE position. Be sure to orient the jumper correctly so pins 1-2 and 3-4 are shorted.

3.4 Line Voltage Calibration

Important: Be sure to perform line voltage calibration after replacing a relay board.

1. Hold the overide button (>37) while powering up the unit to enter the service screen.
2. On the second service screen select CAL LV.
3. Measure the line voltage at the AC connectors located at the bottom of the electrical enclosure.
4. On the CAL LV screen, dial in the mains voltage value that you measured and push the knob to enter it.
5. When calibration is completed screen will say Mains Voltage Calibration Complete.

   If the message "Mains voltage calibration failed. Please enter the mains voltage again" appears this indicates the dialed in line voltage is 20% different than the measured value (not the nominal value).

3.5 Humidifier Calibration

Important: Be sure to re-calibrate the humidifier whenever either the sensor or the control board is replaced.

Important: In order for the water in the calibration bottle to be completely saturated, most of the salt should not be dissolved. There should be as little standing water above the salt line as possible to minimize the response time. The salt in the calibration bottle may only be used for a period of one year after it's initial mix with water then the kit should be discarded.

1. Take the cap off the humidity calibration bottle and add one half cap full of distilled water to the bottle. Shake the bottle to thoroughly mix the salt and water solution. Place the elbow on the bottle. The smaller end goes over the bottle.

2. Slide the elbow over the humidity sensor (mounted on the back wall) until it stops.

3. Hold the override key while powering up to enter the service screen.

4. On the second service screen, select Cal RH. The screen will prompt "Push knob when RH reading is stable." Wait for 20 minutes or until the RH display stabilizes (does not change by more than 1% in 5 minutes).

5. You have the option to select STABLE, SET TO DEFAULT or EXIT. STABLE initiates calibration. SET TO DEFAULT resets calibration values back to factory default settings. If you started calibration by mistake (without the calibration bottle in place, for example) you would select SET TO DEFAULT and then calibrate the unit. If you have entered the calibration routine by mistake, select EXIT to leave without initiating calibration

6. If "RH Sensor Calibration Completed." is displayed the calibration is complete. Depress the knob to exit the Cal RH routine.

7. If "RH Sensor Calibration Failed. Try Again." is displayed verify your setup and press the knob to try the calibration again.

3.6 Scale Calibration

NOTE: The scale is calibrated using a Class F calibration weight between 1 kilogram and 8 kilograms (accuracy of 0.01%).

1. Place the test weight on the center of the bed.
2. Hold the override key (>37) while powering up to enter the service screen.
3. On the second service screen, select Cal Scale.
4. Remove the weight and push the knob at the screen prompt "REMOVE THE WEIGHT AND PUSH KNOB". The screen will prompt "INITIALIZING....." for a few seconds.
5. Replace the weight and push the knob at the screen prompt "PLACE TEST WEIGHT AND PUSH KNOB". The screen will prompt "MEASURING ...." for a few seconds
6. When the screen prompts "ENTER TEST WEIGHT" Dial in the test weight to the nearest gram. Press the knob to enter. The screen will prompt "CALCULATING." for a few seconds.
7. When the screen prompts:
   SAVE AND EXIT
   EXIT ONLY
   RESTORE DEFAULT

   Select and enter "SAVE AND EXIT"
8. Turn off the power to exit the service mode.

3.7 Leakage Current

Use approved equipment and techniques to test the unit's leakage current and ground continuity. Follow the directions supplied by the test equipment manufacturer to verify the following:

1. Less than 300 microamperes measured at any exposed metal surface for equipment rated at 120 Vac, 50/60 Hz.
2. Less than 500 microamperes measured at any exposed metal surface for equipment rated at 220 Vac, 50/60 Hz or 240 Vac, 50/60 Hz.

3.8 Ground Resistance Check

Use a electrical safety analyzer to measure the resistance between the ground pin on the line cord plug and exposed metal of the electronic enclosure. The ground resistance must be less than 0.2 ohms.

4.1 Service Screen

To access the service screen, hold in the override button (>37) during power up until the software revision screen appears. Release the button and the first service screen will appear.

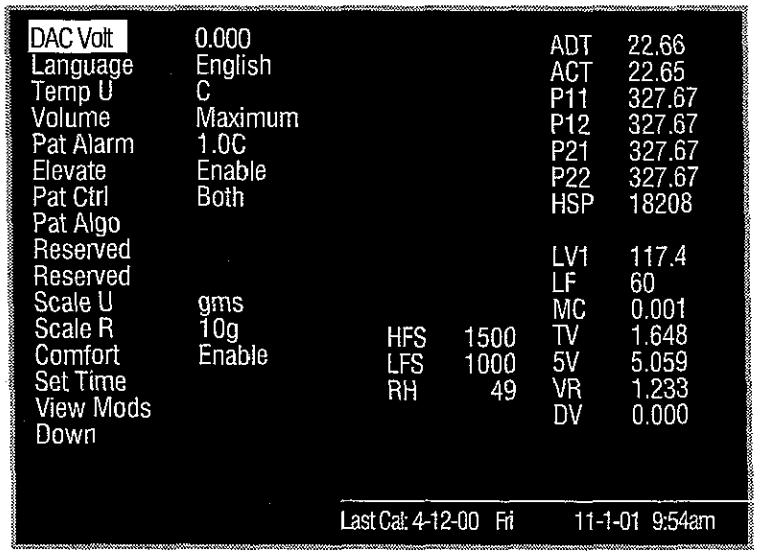


Figure 4-1
First service screen

Default options that may be selected from this screen appear along the left side of the screen

DAC Volt — Digital/Analog Converter voltage. This is the over temperature voltage that is used by the system to verify the computer independent circuitry is working. To manually test this circuit enter voltages from 0 to .5 V. The DV value at the bottom right corner of the screen should match this value within 10mV.

Language — English is the default language that appears on the EL screen, but you can select French, Spanish, etc., depending on what software is installed.

Temp U — Changes temperature displays to show "Fahrenheit", "Celsius" or "Celsius Only" so the Fahrenheit option is not present on the user Set-up screen (Celsius is factory set default).

Volume — Select one of four volume settings; 1 is minimum, 4 is maximum.

Pat Alarm — Set the default Hot Baby/Cold Baby alarm to activate when either 0.5°C or 1.0°C difference is read between a set temperature and the baby probe temperature.

Elevate — Disable or enable the elevating column foot pedal switches.

Pat Ctrl — Allows you to disable patient control.

Pat Algo — To be used for future software options.

Scale U — Select from "Grams", "Pounds" or "Grams Only" so that the pounds option is not present on the user Scale screen (grams is the factory default).

Scale R — Select from 2 scale resolution settings; 10 grams or 5 grams (10 grams is the factory default).

Comfort — Allows you to remove the Comfort Screen feature.

Set Time Set real time clock for time, day and date. Choose how date is displayed (North American or European). Choose a 12 hour (AM/PM) or 24 hour time display.

View Mods Display the current software revision of the options installed on this specific unit (Humidifier, Scale, SPO2, etc.)

Down Go to second service screen.

Up Return to previous screen.

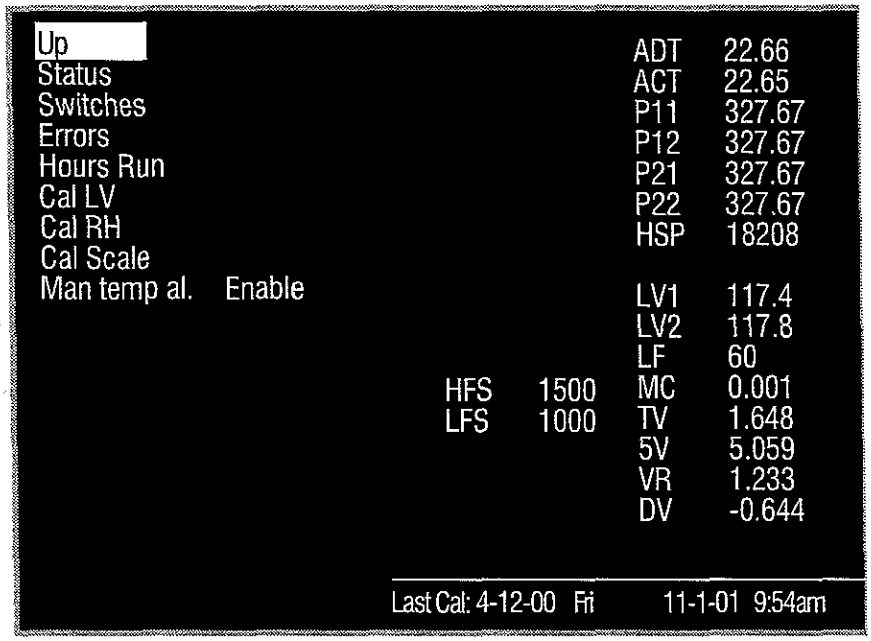


Figure 4-2
Second service screen

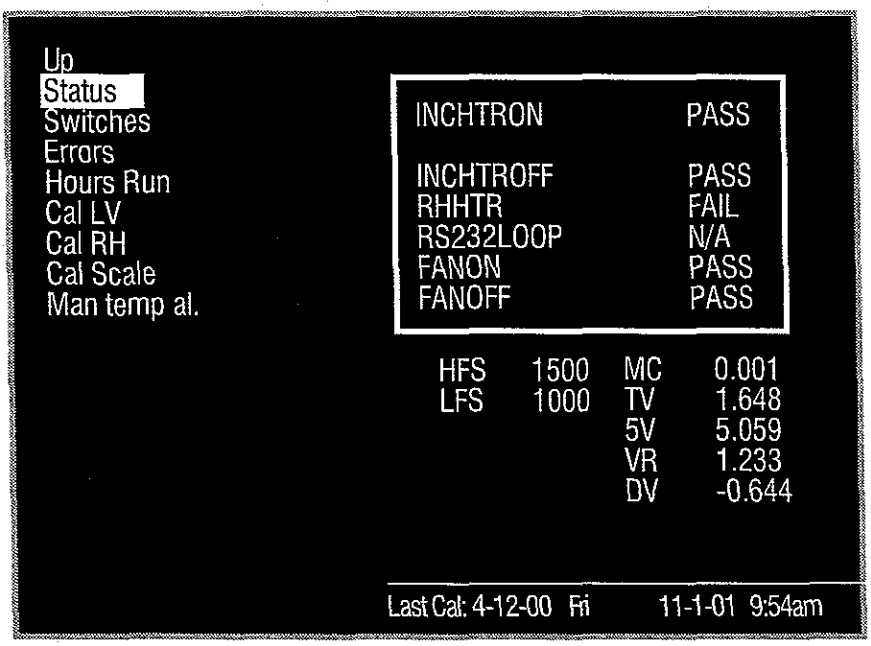


Figure 4-3
Status menu

Status

Check status of all self test the software runs continuously. These include: incubator heater on (INCHTRON), incubator heater off (I/HTROFF), humidifier heater on (RHHTR), remote monitoring data stream (RS232LOOP), incubator fan on (FANON), and incubator fan off (FANOFF).

If the RS232 option is not installed RS232LOOP will display fail. To test the circuit if the option is installed, short pins 2 & 3 on the 9 pin connector on the back of the electrical enclosure.

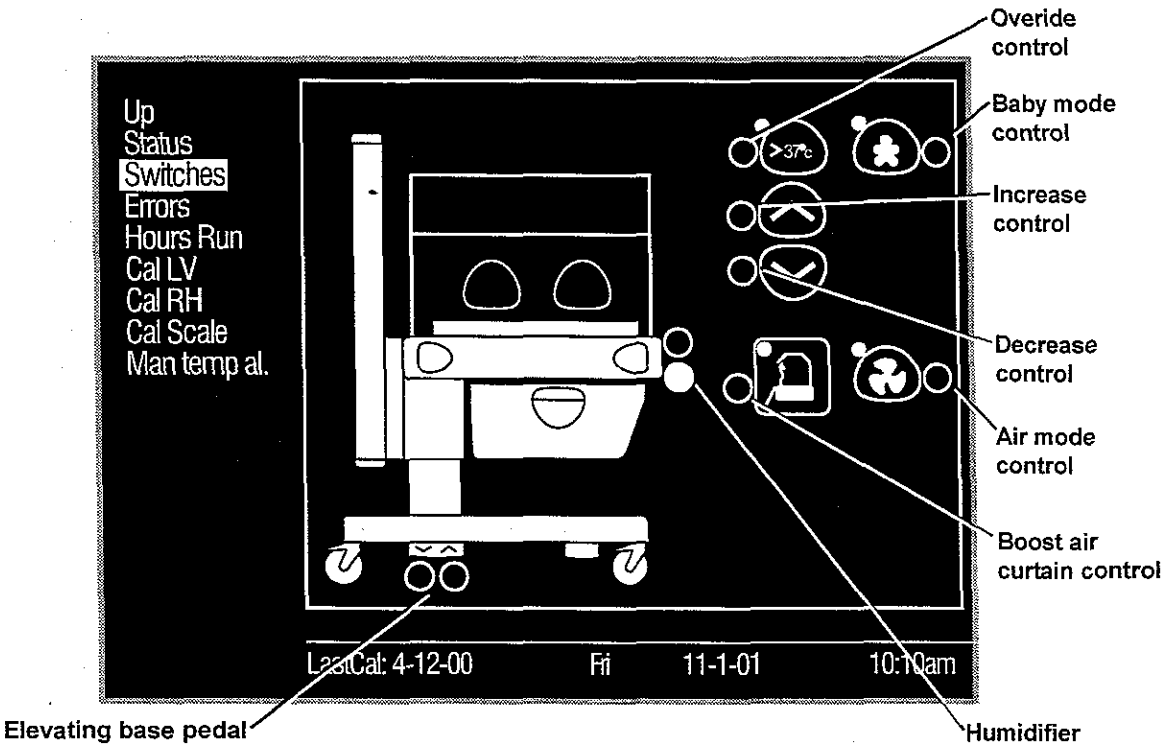


Figure 4-4
Switch diagnostic diagram

Switches

Select to bring up a diagnostic diagram of the unit that displays the status of all the switches. If the circle next to the switch is lit, the switch is closed; if it's not lit, the switch is open. Also, while the switch status screen is active, you can hold down the alarm silence button to light the alarm light, system failure light and all LED segments to test them.

Errors

Lists a chronological log of the last 8 system errors that occurred. Shows error number and date. It is possible to clear the list.

Hours Run

Brings up a screen with 2 hour meters; one that is resetable and one that is not. To reset the resetable hour meter, highlight CLEAR and push the control knob.

Cal LV

Use to calibrate line voltage at the factory. To calibrate line voltage follow the procedure in calibration section (chapter 3) of this manual

Man temp al.

Use to enable or disable the patient temperature alarms in the air mode.

Cal RH

Brings up humidifier calibration screen. See calibration section for information on how this screen is used.

Cal Scale

Brings up scale calibration screen. See calibration section for information on how this screen is used.

A number of diagnostic readings appear on the right side of the service screens.

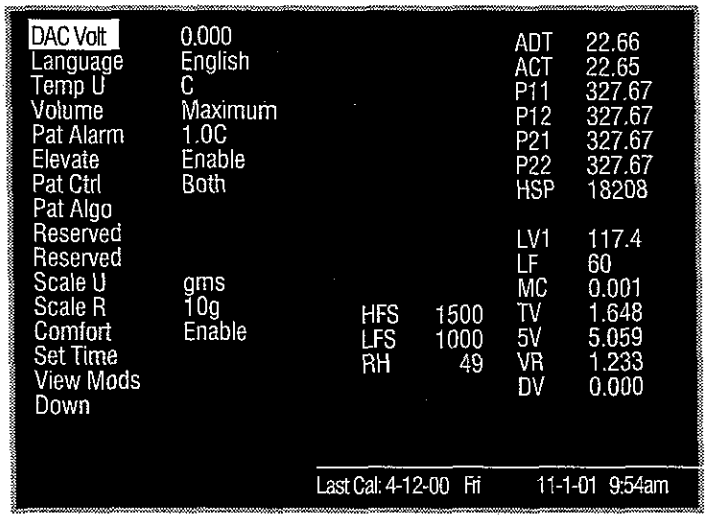


Figure 4-6
First service screen
Diagnostics

HFS	High fan speed. Should be 1500 ± 100 (measured at power up only)
LFS	Low fan speed. Should be 1000 ± 100 (measured at power up only)
RH	Relative Humidity. % humidity read in the patient chamber
ADT	Air display temperature. Temperature read by the first thermistor in the compartment probe. Should be ± 0.3°C of ACT temperature.
ACT	Temperature read by second thermistor in the compartment probe. Should be ± 0.3°C of ADT temperature.
P11	Reading from the first thermistor in patient jack 1. Should be ± 0.3°C of P12 temperature.
P12	Reading from the second thermistor in patient jack 1. Should be ± 0.3°C of P11 temperature.
P21	Reading from the first thermistor in patient jack 2. Should be ± 0.3°C of P22 temperature.
P22	Reading from the second thermistor in patient jack 2. Should be ± 0.3°C of P21 temperature.
HSP	Heat sink probe resistance. Should be approximately 20000 ohms @ 25°C. See section 4.5 for resistannce verses temperature values.
LV1	Line voltage in first mains circuit.
LF	60Hz or 50Hz
MC	Motor current. Shows current drawn by the e-base motor
TV	Thermistor voltage. Voltage of thermistor circuits located on the mother board.
5V	Power supply voltage. Should be ± 0.25V of 5V
VR	Voltage reference. Independent voltage reference. Should be 1.235V ± 1%
DV	DAC output voltage. It should match the DAC volt value within 10 mV.

Across the bottom of the screen the date of last time the temperature and line voltage calibration was performed appears plus the current time settings of the unit.

4.2 Alarm Messages

	CAUSE	ACTION
FAN FAILURE	Fan is missing or not turning.	Verify the fan is installed and turning. During powerup it should spin at low speed for a few seconds, stop for a second, then start again at high speed. If the fan is not turning replace the fan motor.
	Defective optical sensor.	If the fan is turning replace the optical sensor.
	Defective relay board.	If the problem persists replace the relay board.
FAN ALWAYS IN HIGH SPEED	The heat sink temperature sensor thermistor is defective.	Check heat sink temperature sensor thermistor. See tips.
	Defective control board.	If the thermistor is OK replace the control board.
AIR PROBE FAILURE	The air sensor is defective.	Check the air sensor. See tips.
	Defective control board.	If the sensor is OK replace the control board.
BAD MEMBRANE SWITCH	Alarm Silence has been on for more than 20 seconds or one of the temp control switches has been on for more than 50 seconds.	Verify switches. See tips. If these switches are OK replace the graphics driver board.
POWER FAILURE	The 5 volt signal is not present.	Check that power is coming into the unit. Check the power supplies. See tips.
BED HEATER FAILURE	The t-stat is open (possibly because the unit was shut down when the heater was hot) or the heater or t-stat is defective.	If the unit was shut off when the heater was hot, allow the fan to run for several minutes to cool below 40 then power down and back up. If the failure still persists check the t-stst and heater resistance. See tips.
	Defective cable between the relay and control board.	Check cable pins 37, 38, 39, and 40 for continuity.
	Defective incubator solid state relay.	Replace the incubator solid state relay.
	Defective relay board.	Replace relay board.
HUMIDIFIER FAILURE	Humidifier heater will not turn on, because safety T-stat is open or heater is defective.	Wait for the heater to cool. Check safety T-stat and heater resistance. See tips.
BED UP/DOWN PEDAL FAILURE	One of the elevating base up/down switches is shorted.	Check the switches. See tips.
	One of the pedals were touched during power up.	Shut off unit and power up again to clear alarm.
MOTOR DRIVE FAILURE	The elevating base motor was running when not turned on.	Replace the relay board.

4.3 Error Codes

ERROR #	MEANING	CAUSE(S)	ACTION(S)
0	Display driver board not responding. Communication error between the display driver board and the control board	Defective control board, cable, or display driver board	If the error occurs occasionally, may be random causes; e.g., static discharge. If failure persists, check or replace the cable between display driver and control boards. If failure persists, replace the display driver board. If failure persists, replace the control board.
1	No Timer2	The Timer2 circuit of the Microprocessor on control board is defective.	Replace the control board.
2	Timer2 Too Fast	There is no line frequency signal to feed timer0 & timer1 of the micro on control board, or the timer2 of the micro on control board is defective.	Power cycle the unit. If it shows "system failure 8" see the instruction below for "system failure 8". If it still shows "system failure 2", replace the control board.
3	During ADC calibration the software detected a channel out of range.	All of the thermistors were not unplugged during calibration. Defective circuit on control board.	Before calibrating make sure J1, J2 and J4 on the control board are disconnected. Verify JP1 is correctly positioned. Try calibrating again. If the error persists, replace the control board.
5	The 1.235 volt reference is out of the 1.171V - 1.259V range.	ADC out of calibration. Defective control board.	Recalibrate the ADC. Replace control board.
6	Bad overtemp DAC circuit on the control board.	ADC out of calibration. Defective control board.	If the error occurs occasionally, may be random causes; e.g., static discharge. If failure persists, recalibrate the ADC. If failure still persists, replace the control board.
7	1.0 V Thermistor reference voltage is out of 0.95V - 1.049V range.	ADC out of calibration. Defective control board.	Recalibrate the ADC. If the failure still persists replace control board.
8	No Line Frequency	Defective cable between the control board and the relay board. Defective relay board. Defective control board.	Measure the signal on the control board between J9 pin 43, and TP1-6 (Ground). It should be a 120 hertz square wave. If the signal is OK replace the control board. If no signal check the 50 pin cable, pin 43. If bad replace the cable. If cable is OK, replace relay board.

ERROR #	MEANING	CAUSE(S)	ACTION(S)
11	The ADC on the control board is not operating to spec. (too slow)	The humidifier sensor or cable is shorted. Bad control board.	Disconnect J1 on the control board. If the error persists replace the control board. If it powers up OK either the cable or the humidity sensor is bad. Reconnect J1 and disconnect the humidity sensor at the compartment probe. If the unit now powers up OK the humidity sensor is bad, or the cable is bad.
12	Bad Checksum	Defective control board PROM	Change socketed IC U42 on the control board. If failure persists, replace control board.
13	Bad SRAM	Defective SRAM circuit on control board	If the error occurs occasionally, may be random causes; e.g., static discharge. If failure persists, replace control board.
14	Bad WDOG	Defective control board Watch Dog	Replace socketed IC U21 on control board. If failure persists, replace control board.
15	Heater Safety Relay test failure. Unable to turn incubator heater on.	Air temperature sensor is above 40C at powerup. Air display sensor is shorted. Defective relay board Defective DAC circuit on control board. If the error occurs during ADC calibration it could be caused by failure to unplug the probes during calibration.	If the unit was shut off when the heater was hot, allow the fan to run for several minutes to cool to below 40 then power down and back up. Check the air sensor. See tips. If failure persists, replace relay board. If failure persists, replace control board. Make sure J1, J2 and J4 on the control board are disconnected. Verify JP1 is correctly positioned then recalibrate.
16	Bad Incubator Solid State Relay. Unable to turn the incubator heater on.	The bed Tstat is open (possibly because the unit was shut down when the heater was hot) or the heater or t-stat is defective. Defective cable between the relay and control board. Defective incubator solid state relay. Defective relay board.	If the unit was shut off when the heater was hot, allow the fan to run for several minutes to cool to below 40 then power down and back up. If the failure still persists check the t-stat and heater resistance. See tips. Check cable pins 37, 38, 39, and 40 for continuity. Replace the incubator solid state relay. Replace relay board.
17	Not Used		
18	Bad Variables	Defective SRAM circuit on control board.	Replace the control board.
19	No Audio Frequency	Defective audio circuit on control board.	Replace socketed IC U22 on control board. If failure persists, replace the control board.

ERROR #	MEANING	CAUSE(S)	ACTION(S)
20	Display WDOG Time Out	Display board software upset.	If the error occurs occasionally, may be random causes; e.g., static discharge. If failure persists, replace display board.
22	During operation the system was unable to turn ON the incubator heater.	See other errors.	Power down the unit. During the system tests after power-up the unit should detect system failure 15, bed heater failure. Follow the tips for those failures.
23	During operation the system was unable to turn OFF the incubator heater	Defective solid state relay.	Replace the SSR.
24	Bad Air Temperature Sensor. The system detected a difference in the two air thermistors of >0.3 degrees C.	Bad air sensor. Bad control board.	This failure is normally caused by a faulty air temperature sensor. When the error occurs, observe the difference between the air control and air display thermistor readings on the service screen. If the difference exceeds 0.3°C, replace the air temperature sensor and repeat the test. If the error persists, replace the control board.
25	Bad Air Flow	Fan is missing or not turning. Defective optical sensor. Defective relay board.	Verify the fan is installed and turning. During powerup it should spin at low speed for a few seconds, stop for a second, then start again at high speed. If the fan is not turning replace the fan motor. If the fan is turning replace the optical sensor. If the problem persists replace the relay board.
26	During the power up tests the system was unable to turn off the RH safety relay.	Defective relay board.	Replace the relay board.
27	Bad non-volatile memory	Defective circuit on control board.	Replace the control board.
28	The display driver board lost communication with control board	Defective cable Defective control board.	Verify the cable between control board J8 and display driver board is installed properly and is pin to pin connected. Replace control board.
29	Bad 5VAN signal on control board.	Defective cable, control board, power supply, or relay board.	Check the system power supplies. See tips.

ERROR #	MEANING	CAUSE(S)	ACTION(S)
30	Line Circuit Failure	Line voltage is out of range.	Measure the line voltage at the power socket, it should be 99-132V or 198-264V. If it is out of this range, the line voltage is out of spec.
		Line Voltage Comp Circuit is not calibrated correctly.	Calibrate the unit.
		Defective relay board.	If the failure persists, measure the voltage at the relay board, J37 pin 48 to J37 pin 45. If the line voltage is 115V, the measured voltages should be 3-5V. If the line voltage is 230V, the measured voltage be 7-10V. If not, replace the relay board.
		Defective cable.	If the failure persists measure the same voltage at the control board, J9 pin 48 to J9 pin 45. If the voltage is bad the cable is bad.
		Defective control board.	If the voltage is OK replace the control board.
33	Bad RH Solid State Relay	Defective RH Solid State Relay	Replace relay board
34	Software revision level does not match	The software revision of the control board and the display driver board does not match	This error may occur after replacing the control or display driver board. Check Software revision on power up. Replace the software EPROM
35	Wrong dipswitch set up		Check the 8 position dipswitch on the control board. Verify that Switch 1 is on and Switch 2 is off.
50	Display Bad Checksum	Defective PROM on the display driver board	Replace socketed IC U5 on display driver board. If failure persists, replace display board.
51	Display Bad SRAM	Defective SRAM circuit on the display driver board	If the error occurs occasionally, may be random causes; e.g., static discharge. If failure persists, replace display driver board.
52	Display No Timer2	Defective display driver board micro circuit.	If the error occurs occasionally, may be random causes; e.g., static discharge. If failure persists, replace display driver board.
53	Display Timer2 Too Fast	Defective display driver board micro circuit.	Replace the display driver board.
55	Display board On Line Self Test Failure	Defective display driver board SRAM circuit.	If the error occurs occasionally, may be random causes; e.g., static discharge. If failure persists, replace display driver board.
98	Overflow	Software upset.	If the error occurs occasionally, may be random causes; e.g., static discharge. If failure persists replace the control board.
99	Logic problem on the control board.	Software upset	Replace the control board.

4.4 Troubleshooting Table

SYMPTOM	POSSIBLE CAUSE	ACTION
No audio alarm.	Defective speaker. Audio driver circuitry is defective.	Use an ohmmeter to verify the speaker resistance is about 8 ohms. (J40, pins 5-6) Replace the control board.
Unit equipped with servo-humidity but unable to set RH setpoint above 10 and % indicator is not displayed.	Unit is functioning as a manual humidifier. Look at the air sensor and verify the humidity sensor is installed. Defective humidity sensor. Defective control board.	If the sensor is not installed the unit is operating correctly. No action required. Replace the humidity sensor. If problem persists, replace control board
ADD WATER message stays on even after water has been added	Humidifier reservoir switch is jammed.	Remove reservoir, but take care because surface may be hot! Check that the white button on the reservoir switch moves freely. Listen for switch to click when the button is depressed.
Elevating base will not go up or down	Defective switch. Defective e-base motor. Defective relay board. Defective cable. Defective control board. Pedals disabled on Setup screen	Check switches. See tips. Check voltage to the e-base. See tips. If OK replace the e-base motor. If bad check the input signals on the relay board. See tips. If OK replace the relay board. If bad check the output signals from the control board. If OK then the cable is bad. If signals are incorrect replace the control board. Check Setup screen (wrench symbol) to see if pedals are disabled.
Unit will not switch to Baby Control Mode	A patient probe is plugged into Jack 2 on the probe panel Baby Control is disabled on Service screen	Disconnect probe from Jack 2 (unit will only allow Baby Control operation with a single probe in Jack 1) Select BOTH for Baby Control on service screen.
Unit will not power up	Defective scale Defective battery	Disconnect scale. If unit powers up, scale is defective. Remove the electrical enclosure cover and disconnect the battery. Power down and power up aqain. If the unit powers up, replace the 9V battery (6600-1024-600).
Baby Hot or Baby Cold alarms activated while unit is in Air Mode	MANUAL TEMP alarm is selected on the Setup screen	Select OFF for MANUAL TEMP alarm on Setup screen.
Air Temp >38C or Air Temp >40C alarm activated and heater is operating even though compartment temp is ≤ alarm	Alarm is not designed to automatically reset after alarm condition is resolved.	Shutoff unit and power up again to clear alarm.

4.5 Additional Troubleshooting Tips

Following are tips on taking many of the measurements and diagnosing the failures that are referred to in the troubleshooting charts.

INCUBATOR AIR HEATER AND THERMOSTAT

There are two separate incubator heaters. They are connected in parallel for 115 volt operation and in series for 230 volt operation. Measure between the black wire on the incubator SSR and J49 pin 2 on the relay board.

The resistance of each heater is about 48 ohms so it should measure about 24 ohms for 115 units, 96 ohms for 230 units. The heater and t'stat are in series so if the reading is open circuit you must determine which is defective.

POWER SUPPLIES

The 5V and 12V supplies are generated on the power supply. Measure the power supply output at the input to the relay board.

Signal	Location	Value
+5V	J41 pins 1-4	4.75 to 5.25
+12V	J41 pins 4-7	10.8 to 13.2

+5STBY is generated on the relay board. The output of the relay board can be measured on the power supply bus cable coming off J42 on the relay board.

Signal	Location	Value
+5V	J42 pins 1-2	4.75 to 5.25
+5VSTBY	J42 pins 1-4	4.75 to 5.25
+12V	J42 pins 1-3	10.8 To 13.2

+5VAN and -5VAN are generated on the control board and can be measured on the test points on the control board.

Signal	Location	Value
+5V	TP2 pins 1-4	4.75 to 5.25
+5VSTBY	TP2 pins 3-4	4.75 to 5.25
+5AN	TP1 pins 5-6	4.75 To 5.25
-5AN	TP1 pins 4-6	-4.5 To -5.5

SWITCHES/TSTAT

Use switch status diagram on the second service screen to assist in troubleshooting the switches.

Humidity reservoir	Relay bd J32 pins 2-3	Closed when reservoir is closed
Add water t-stat	Relay bd J32 pins 1-3	Opens when reservoir needs water

The following switches are membrane switches. When closed the resistance should be less than 200 ohms.

DISPLAY TOUCH PANEL SWITCHES

Alarm Silence	Graphics Driver bd J21 pins1-2	Closed when switch is pressed
>37 degrees	Graphics Driver bd J21 pins1-3	Closed when switch is pressed
Servo Control	Graphics Driver bd J21 pins1-4	Closed when switch is pressed
Up	Graphics Driver bd J21 pins1-5	Closed when switch is pressed
Down	Graphics Driver bd J21 pins1-6	Closed when switch is pressed
Intervention	Graphics Driver bd J21 pins1-8	Closed when switch is pressed
Manual Mode Inc.	Graphics Driver bd J21 pins1-9	Closed when switch is pressed

E'base

Left or right up	Relay bd J40 pins 2-4	Closed when either switch is pressed
Left or right down	Relay bd J40 pins 1-4	Closed when either switch is pressed

HUMIDIFIER HEATER/SAFETY T-STAT

The humidifier has two separate heaters that are connected in parallel for 115 volt operation and in series for 230 volt operation. The safety t-stat is in series with the heater. Measure at J53.1 to J53.3

The resistance of each heater is about 144 ohms so it should measure about 72 ohms for 115 units, 288 ohms for 230 units.

AIR PROBE and PATIENT PROBE

There are two thermistors in each air probe or patient probe. During stable temperature conditions the thermistors should read the same resistance within a few ohms.

Patient probe #1	Control bd J4 pins 1-3, 2-3
Patient probe #2	Control bd J2 pins 1-3, 2-3
Air probe	Control bd J1 pins 1-2, 3-4

Temperature (C)	Resistance (Ohms)
20	12527
25	10000
30	8037
35	6500

INCUBATOR HEAT SINK TEMPERATURE SENSOR THERMISTOR

Thermistor	Control bd J3 pins 1-2

Temperature (C)	Resistance (Ohms)
20	25000
25	20000
30	16102
35	13048
40	10636

E-BASE MOTOR

The e-base is driven at 24 volts DC (acceptable range 24-32). The following chart shows the control signal values and the output voltages for each of the motor conditions.

Switch	Control Signals, Relay Board				E-base	
	J37 pin 23 24V SELECT	J37 pin 26 E/H ACTIVATE	J37 pin 24 NVERTPOLARITY	J37 pin 27 E/H SELECT	J45-1	J45-2
Raise E-base	0	0	1	0	+24V	Gnd
Lower E-base	0	0	0	0	Gnd	+24V
None	NA	1	NA	NA	NA	NA

Use Static Control Work Station to help ensure static charges are safely conducted to ground. The velostat material is conductive; do not place electrically powered boards on it. Whenever this symbol appears beside a procedure, take static control precautions.

WARNING ⚠ After performing any repair or calibration, always perform the Service Checkout Procedure before putting the unit back into service.

5.1 Hood Removal for Replacement (Figure 5-1 and 5-3)

1. Open both the side doors.
2. Using a small straight blade screwdriver, remove the 2 snap fasteners from the inside of the hood that secure the hood to each of its hinges. Each fastener has two halves that snap together and can be pryed apart.
3. Remove the compartment probe and cable clip on the hood backwall as descibed in section 5.3.
4. Push the trigger on the hood latch post to disengage the latch and carefully lift the hood off the chassis.

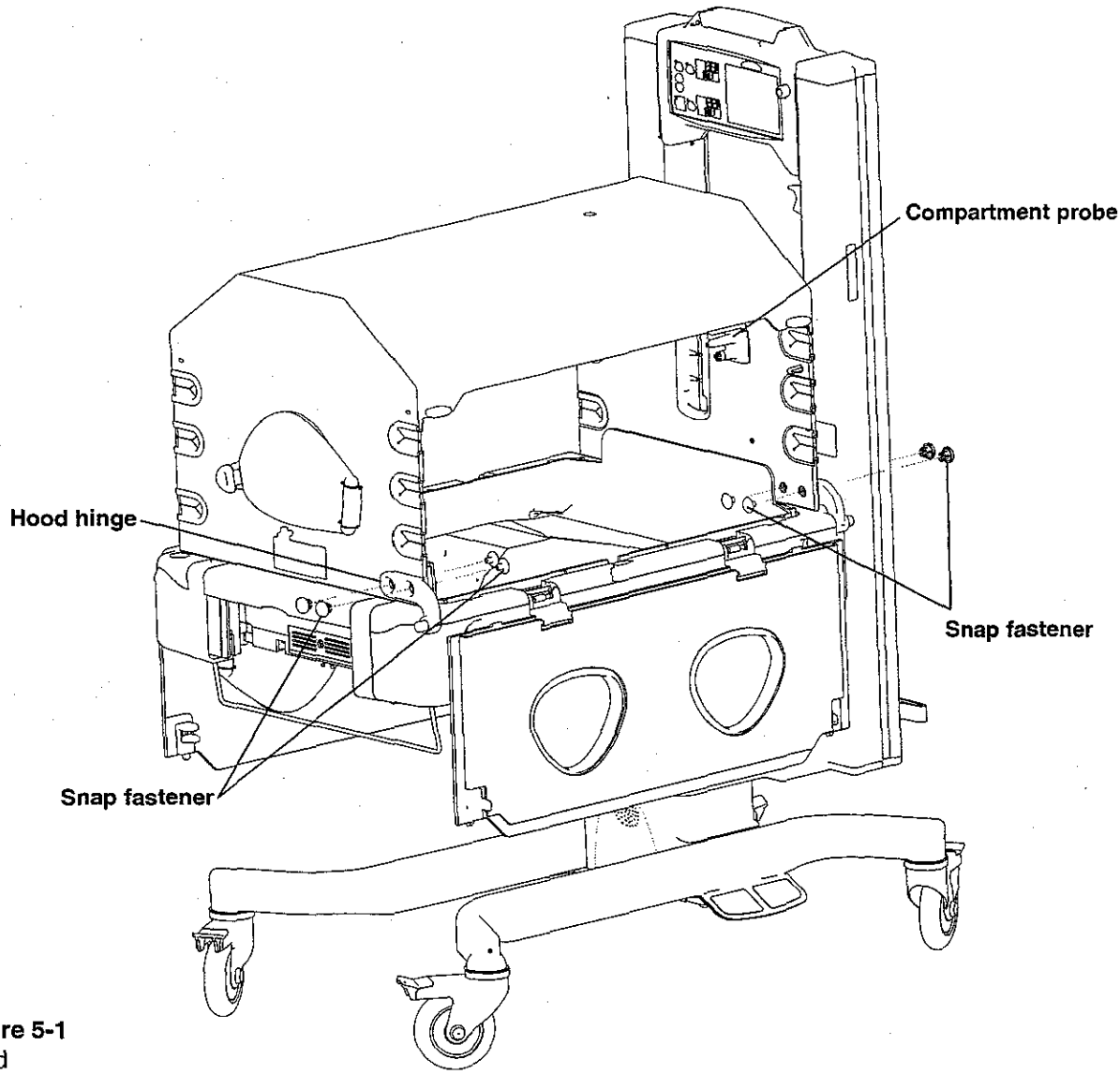


Figure 5-1
Hood

5.2 Uprights and End Caps (Figure 5-2)

1. Slide the decorative strip up about ½" in the groove on the outside of the upright to access hardware that secures the lower end cap. You may wish to use a piece of tape to grip the strip. Use a 2.5mm hex key to remove the screw, then remove the bottom cap. Slide the decorative strip down to access the two screws that secure the upper end cap, then remove the top end cap.

2. Using a 2mm hex key, remove the 4 button head socket screws and split ring washers that secure the back cover to the display module and remove the cover.

3. Remove the 2 screws that secure the hood latch receptacle to the upright and remove the receptacle.

4. Using a 2mm hex key, remove the screw that secures the wire cover to the side of the upright.

5. To remove the wire cover, slide the wire cover up about ½", and then pull it straight back by grasping its back edge.

6. Using a 3mm hex key, remove the 2 screws that secure the display module to the nut bar and pull the nut bar up and out of the upright. Using a 3mm hex key, remove the screw that attaches the ground wire. Be careful not to drop the star washers down into the upright.

7. Hold on to the upright, and using a 4mm hex key, remove the 2 screws in the holes in the lower side of the upright . Remove the entire upright.

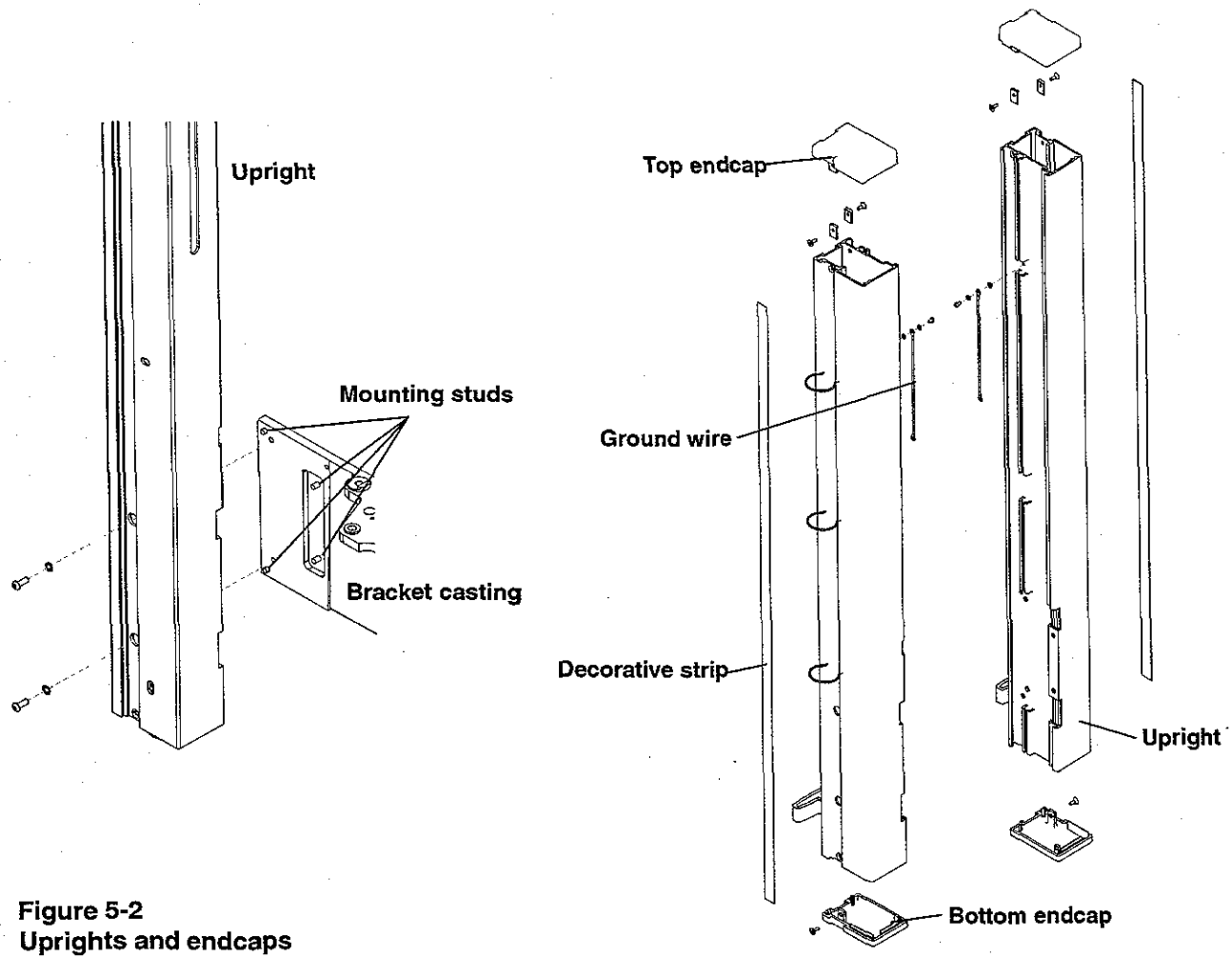


Figure 5-2
Uprights and endcaps

Re-installing the upright

1. To assist in reattaching the upright to the unit, there are four mounting studs on the bracket casting that mate with four holes in the upright. Place the upright on the studs. Be careful not to pinch any wires between the unit and the upright.

2. Secure the upright to the unit by reinstalling the 2 screws in the holes inside the upright. Apply LOCTITE™ 242 to the screws. Be careful not to drop the screws into the upright.

3. Attach ground wire to rail. Fasten the dispaly module to the upright with the two screws and nut bar removed earlier.

4. Reinstall the wire cover. Take care to route the wires in the upright channels and not to pinch them with the cover when securing with the screw.

5. Reistall the hood latch receptacle with the two screws removed earlier.

6. Attach ground wire to rail. Fasten the display module to the upright with the two screws and nut bar removed earlier.

7. Fasten the back panel to the display module with its 4 mounting screws.

8. Slide the decorative strip up and install the end caps.

5.3 Compartment Probe Repairs (Figure 5-3)

1. Using a 2.5mm hex key, remove the screw that secures the jack cable clip to the hood back wall.

2. Remove the 2 screws (2mm hex key) that secure the probe housing cover and remove it. The top screw secures the probe shield, so that it can now be removed from the inside front of the probe housing.

3. Disconnect the electrical connectors for the temperature and humidity sensor (if installed) wires and remove the front of the probe housing.

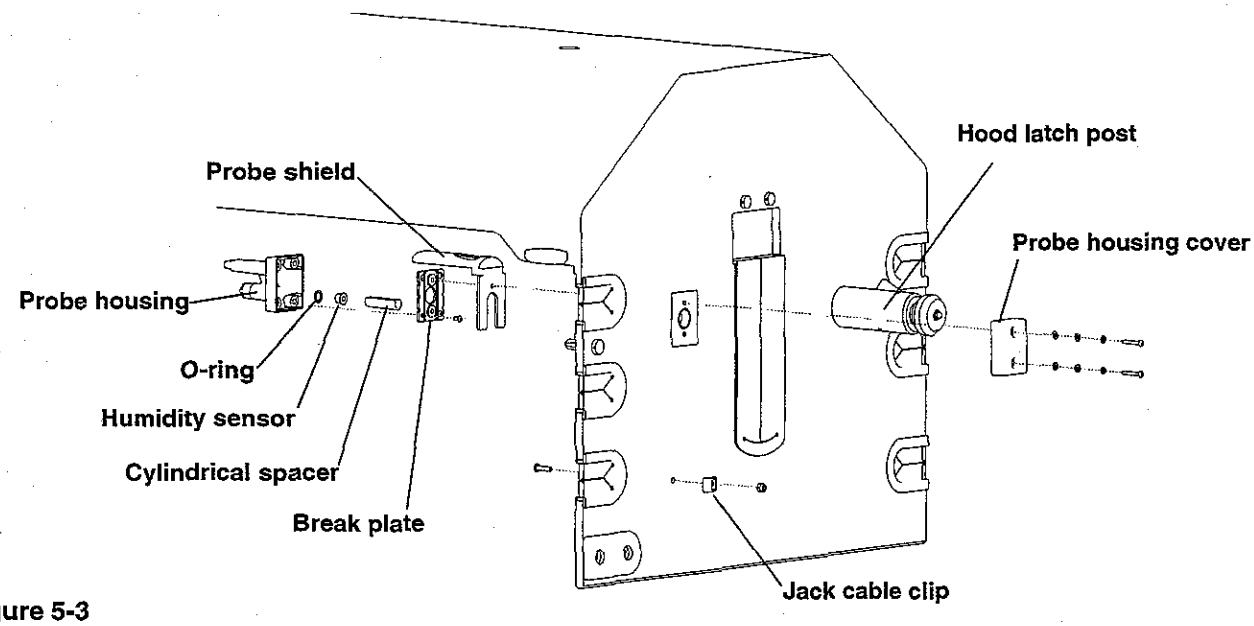


Figure 5-3
Compartment probe

Note: Some early units have temperature probes with jack connectors at the probe panel and should be disconnected there.

4. Remove the 4 screws in the break plate and remove the plate.

5. To replace humidity sensor, pull it back out of the probe housing. Slide the wires out of the cylindrical spacer. Place the O-ring over the tip of the new sensor, and gently push it back into the housing using the cylindrical spacer until the O-ring seats. The sensor tip should be visible, but not up against its guard. Check to ensure that the O-ring did not roll over the sensor flange during insertion.

   Note: Always perform Humidifier Calibration after replacing the humidifier sensor.

6. To replace the temperature sensor, you must replace the entire probe housing.

7. When reassembling the probe housing make sure the groove in the break plate faces the probe housing cover. Also check that the temperature sensor is oriented so that it is on top.

5.4 Lower Unit Repairs

5.41 Removing the chassis cover with the storage drawer in place (Fig. 5-8)

1. Slide the drawer all the way over in one direction, and use a 2.5 mm hex key to remove the 3 chassis cover screws on one side.

2. Slide the drawer to the other side and remove the 3 remaining screws from the cover.

3. Remove the humidifier reservoir.

4. Remove the bottom 2 screws (2mm hex key) that secure the right end of the wire raceway cover.

5. Flex the raceway cover and carefully slide the cover panel forward until it drops off the back drawer slide.

6. Rotate the cover slightly and push it out the right side of the unit.

7. Remove the ground wire.

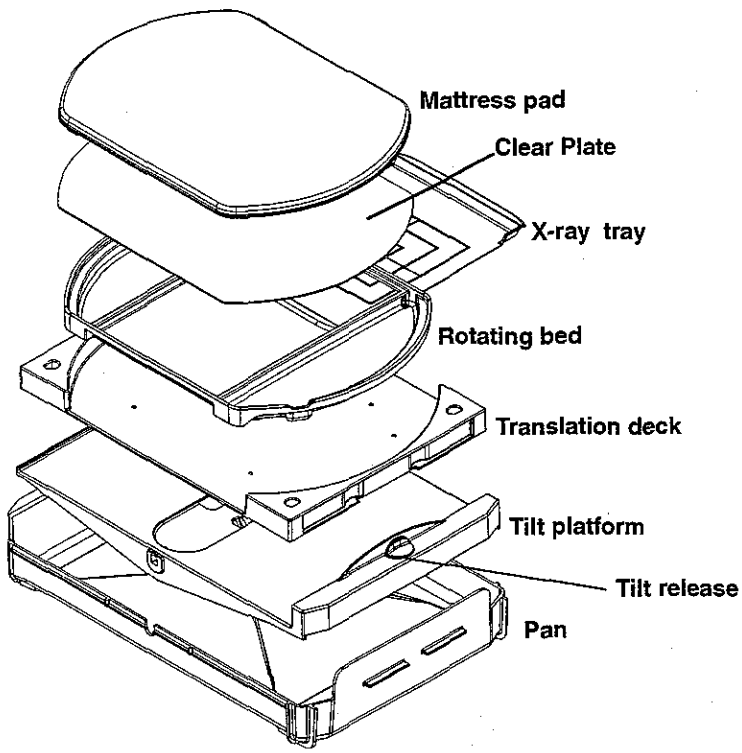


Figure 5-4
Bed disassembly

5.42 Incubator fan/motor/optical sensor (Figure 5-5 and 5-6)

1. Remove the rotating bed, translation deck, tilt platform and pan.
2. Remove the fan, rubber adapter and fan seal from the top of the fan motor shaft.
3. Remove the chassis cover (see section 5.41).
4. Disconnect the motor leads.
5. Remove the 4 screws in the motor bracket and remove the motor assembly.
6. The motor isolators pop out of the holes in the bracket.
7. To replace the optical sensor, disconnect its connector, remove the screw from the boss in the chassis that holds it in place, and remove the assembly.

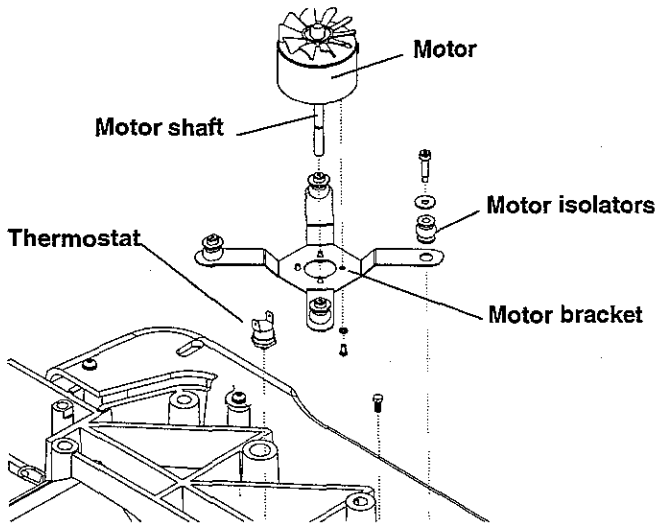


Figure 5-5
Fan motor

5.43 Cartridge heater replacement (Figures 5-6 and 6-9)

To remove the heater closest to the foot of the bed:

1. Remove the chassis cover (see section 5.41).
2. Remove the screw (4mm hex key) in the heatsink directly in front of the heater cartridge.
3. Disconnect the heater's electrical connector.
4. Remove the retaining clip and slide the cartridge out of the heat sink.

To remove the heater closest to the head of the bed:

1. Remove the rotating bed, translation deck, tilt platform and pan.
2. Remove the fan, rubber adapter and fan seal from the top of the fan motor shaft.
3. Remove the chassis cover (see section 5.61).
4. Disconnect the heater's electrical connector, the thermostat connections and the heat sink probe connector.
5. Remove the upper shroud.
6. Remove the 14 mounting screws that secure the heat sink. Remove the heatsink.

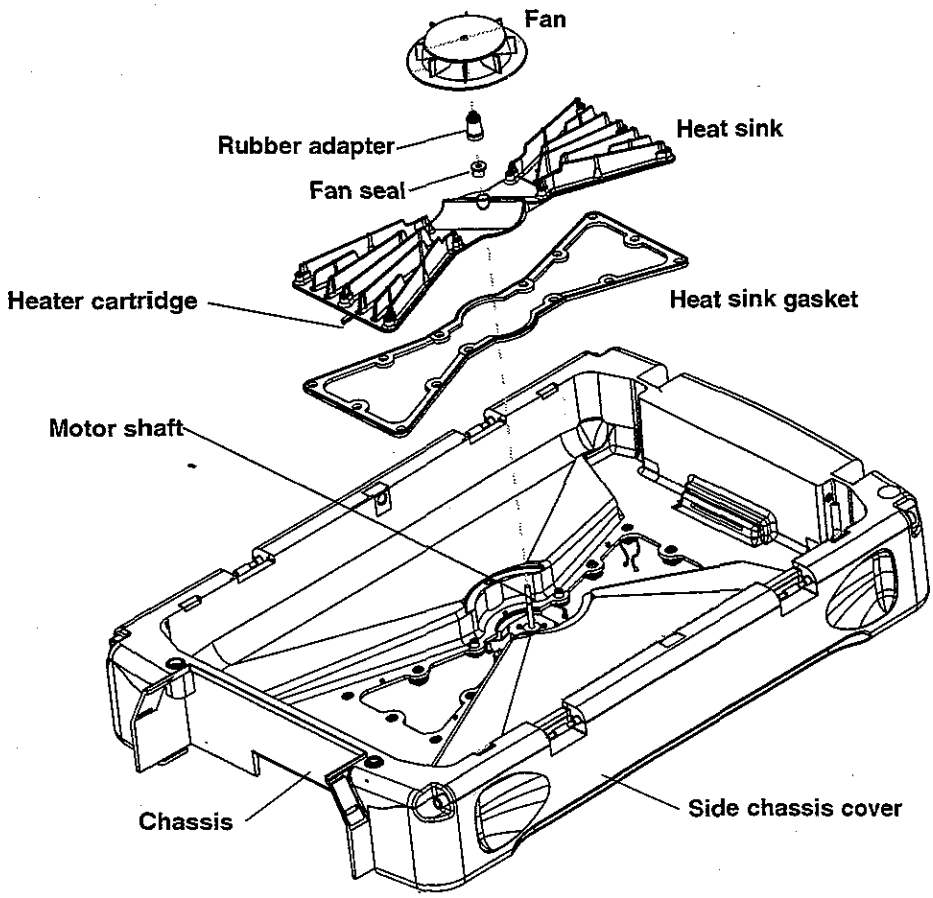


Figure 5-6
Heat sink and fan

7. Remove the retaining clip and slide the cartridge out of the heat sink.

8. To reassemble, seat the fan seal in the center bore of the heatsink and use it to align the fan shaft before fully securing the heat sink with its mounting screws.

5.44 Elevating Base (Figures 5-4 and 5-7)

1. Run the elevating base to its top travel limit then switch off and unplug the unit.

2. Remove the mattress, bed and translation deck.

3. Remove the chassis cover (see section 5.61).

4. Disconnect the elevating base electrical connector at J-45 on the relay board, and tie a wire to it so you can fish it back through during reassembly.

5. Connect the replacement elevating column to the relay board, switch the unit back on and using the foot pedals fully extend the new column. Switch off and unplug the unit.

5. Using a 4mm hex key remove the 4 screws (at the bottom of the base- 2 in back and 2 in front) that secure the lower shroud and slide it up past the speaker.

6. Using 3mm hex key remove the 8 screws that secure the upper shroud and remove it.

7. Pull the base wire harness out from the bracket casting.

8. Lock the back castors and lay the unit down on its back (controller on the floor). Place blocks under the uprights so the back castors are off the floor.

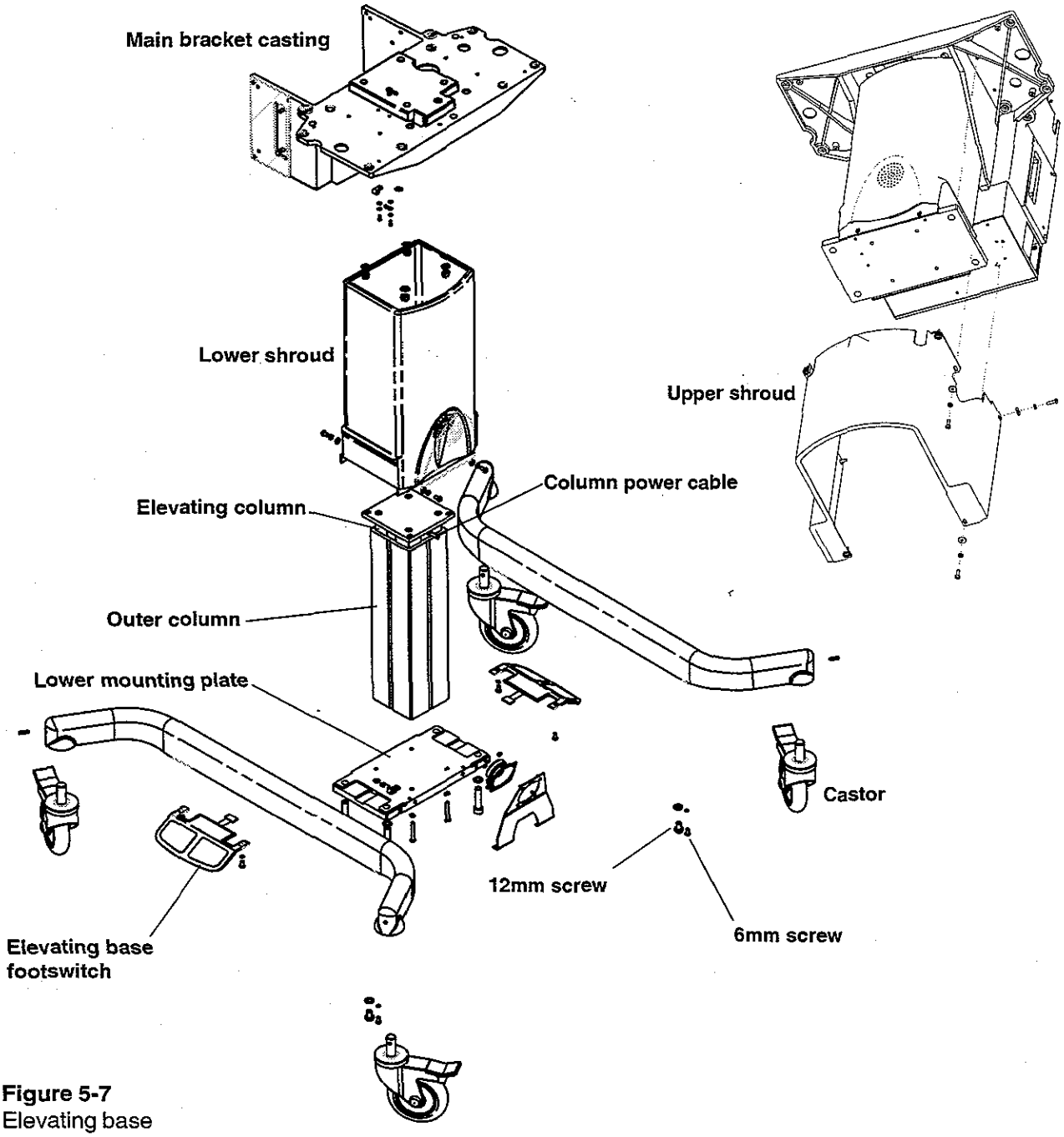


Figure 5-7
Elevating base

9. Using a 4mm hex key, remove the four socket head screws in the bottom of the elevating column that secure the lower mounting plate to the column, and remove the mounting plate/leg assembly.

10. Using a 13mm socket, remove the 4 nuts that secure the elevating column to the casting and remove the column.

    Note: Should the elevating column fail in the completely retracted position, the outer column will prevent access to the 4 column mounting nuts. To remove the outer column, you must first remove the lower mounting plate and slide the outer column out. This requires a T-30 Torx key (service tool number 6600-1204-400)

11. To replace the column, reverse the assembly steps above. Check that the castors are still locked before lifting the unit back into its upright position. If you are returning the old elevating column in it's original

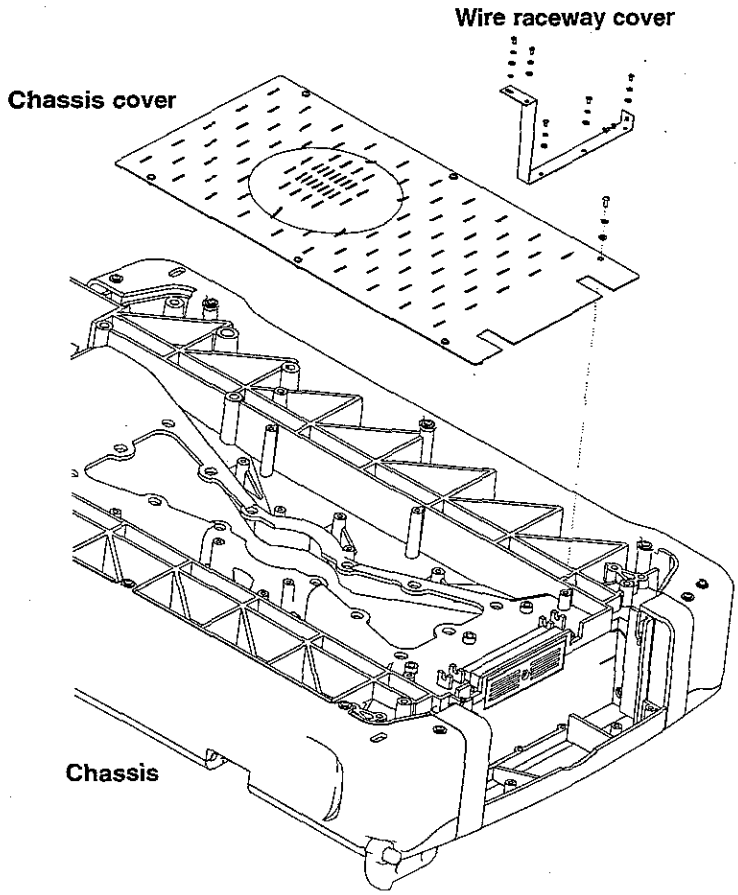


Figure 5-8
Chassis bottom cover

packaging, attach it to the relay board and run it down to it's fully retracted position. Release the shipping locks.

Note: With the unit on its back, be sure the column power cable is pointing up before you attach the column.

5.45 Chassis Replacement (Figure 5-4, 5-5, 5-6, 5-8, and 6-11)

1. Remove the side doors, hood,(see section 5.1) rotating bed, translation deck, tilt platform and pan.
2. Remove the bottom chassis cover, (see Section 5.41) and remove the two side chassis covers (3 mm hex key)
3. Disconnect the wiring harnesses.
4. Remove the two screws at the bottom corners that secure the probe panel to the enclosure (see 5.72)

WARNING ⚠ Be sure the front of the chassis is supported before removing the screws from the bracket to prevent the chassis from falling.

5. While supporting the chassis, remove the 5 bolts on either side of the bracket casting that secure the chassis to the bracket and remove the chassis.
6. Remove all the components from the old chassis (bed tilt; fan and motor; heatsink; humidifier; front hinge covers, side panels, etc.) and install them on the new chassis.

5.46 Elevating Footswitch (Figure 5-7)

1. Run the bed up to the elevating base's top travel limit. Unplug the unit.
2. Using a 4 mm hex key remove the 4 screws (at the bottom of the base- 2 in back and 2 in front) that secure the lower shroud and slide it up past the speaker.
3. Make note of the switches' electrical wire routing; the cable from the replacement switch must feed up through the same slot.
4. Using a 4 mm hex key, remove the button head socket screws on either side of the foot pedal, located between the column base plate and the leg wire cover.
5. Pull the pedal out and disconnect the switch electrical connector. Discard old footswitch/pedal assembly.
6. Install new footswitch/pedal assembly. Make sure that you do not pinch the electrical wires.

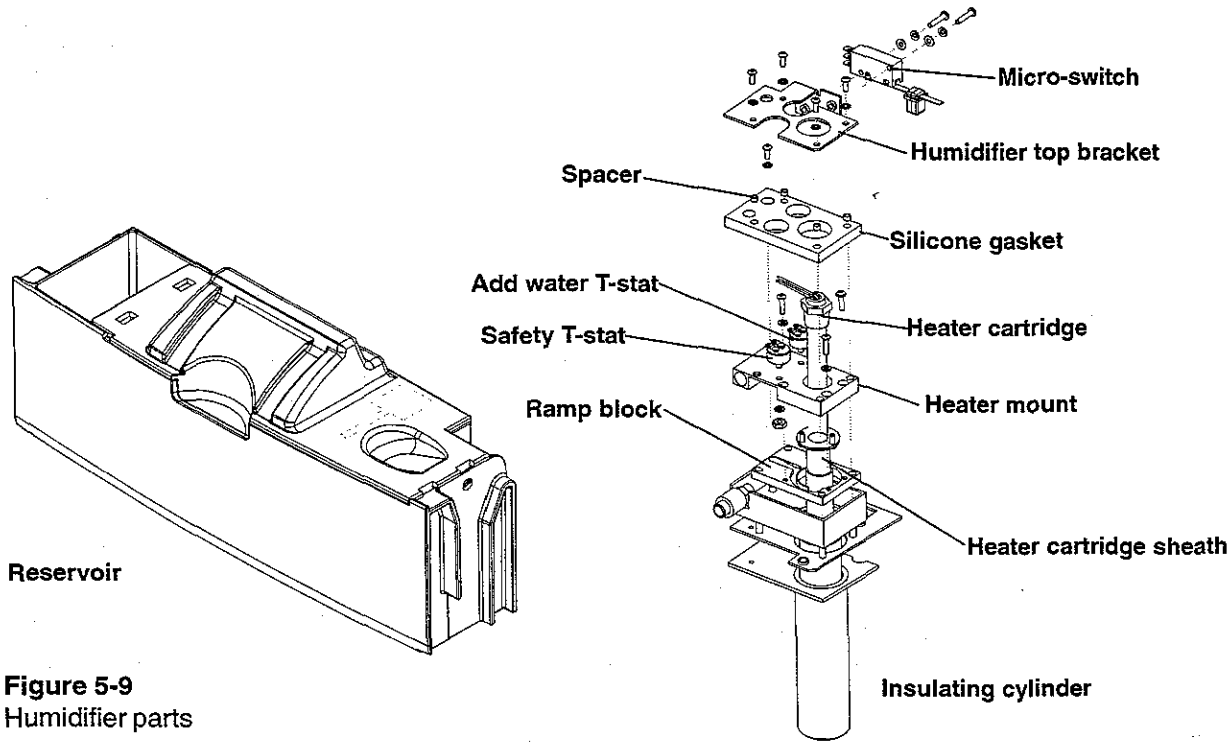


Figure 5-9
Humidifier parts

5.47 Humidifier Heater Replacement (Figures 5-8 and 5-9)

1. Remove the humidifier reservoir.
2. Remove the 6 screws (2mm hex key) that secure the wire raceway cover and remove the cover.
3. Remove the chassis cover (see section 5.41).
4. Disconnect the 3 electrical connectors.
5. Remove the 2 screws on either side of the humidifier heater assembly.
6. Remove the humidifier heater assembly.
7. Use a 2mm hex key to remove the 2 screws from the micro-switch and remove the switch.

8. Remove the 5 screws that secure the humidifier top bracket. Back the bracket off feeding the wire harnesses through as you remove it.

9. Remove the silicone gasket, feeding the wire harnesses through as you remove it. The thermostat wire harness can slide through the slots in the gasket.

10. Remove the 4 screws in the heater mount. Loosen the screw next to the safety thermostat, but do not remove it. Remove the ramp block.

11. Remove the 3 screws in the heater cartridge sheath.

12. To remove the heater cartridge, unscrew it from it's threaded hole. To remove either of the thermostats, remove the nuts that secure them.

    When reassembling, tighten the heater cartridge into it's threaded hole, then back it off until the wires exit between the 2 thermostats. If either thermostat or the heater cartridge is being replaced, check all components (especially the plastic ones) for signs of heat damage or corrosion. We recommend replacing the sheath when replacing the heater cartridge.

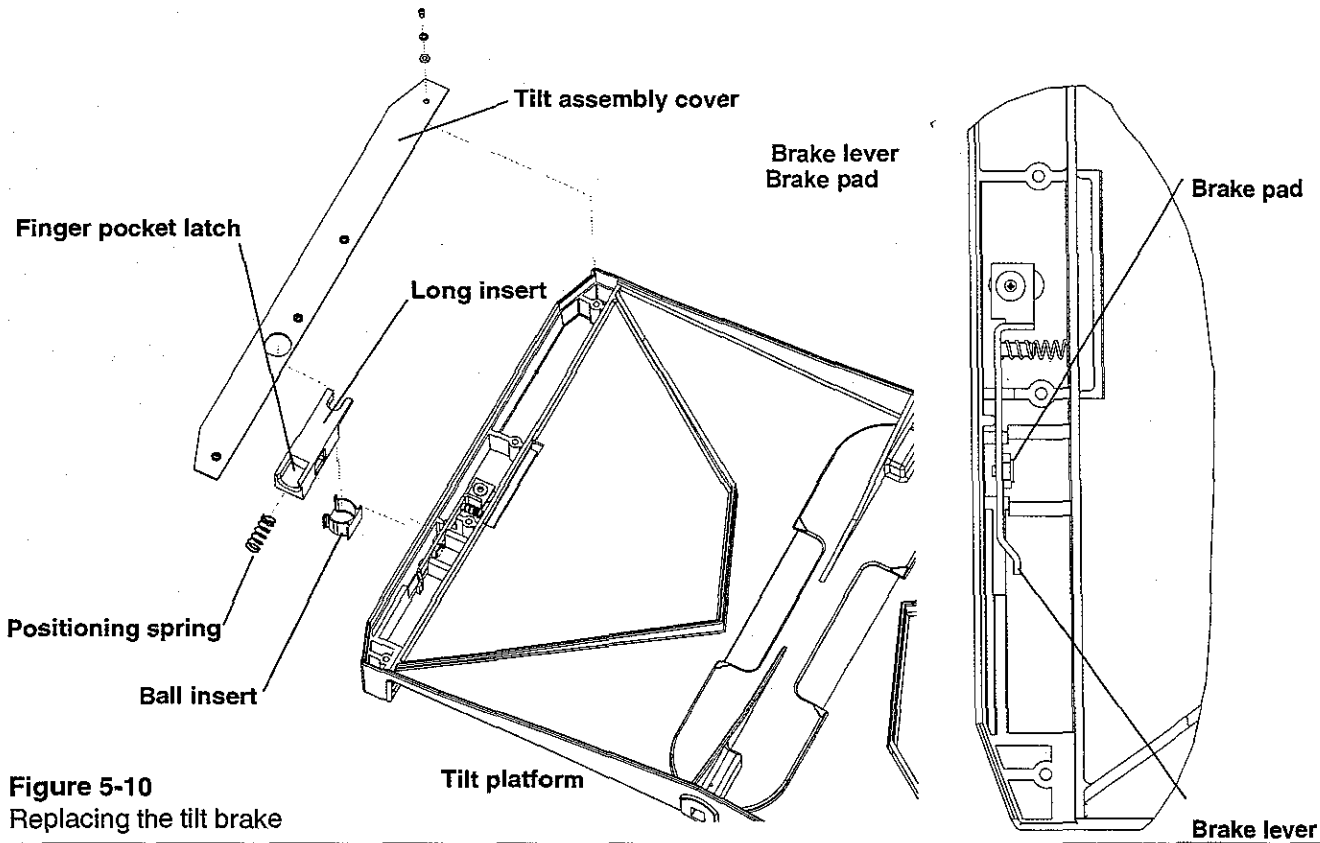


Figure 5-10
Replacing the tilt brake

5.5 Bed tilt brake shoe replacement (Figures 5-4 and 5-10)

1. Remove the mattress, clear plate, rotating bed and translation deck.

2. To release the tilt screw ball, squeeze the tilt release and slide open the finger pocket latch until you hear the ball drop.

3. Release the tilt platform from the chassis by pushing the pivot pin tabs in on both sides, then lifting the tilt platform out of the chassis.

4. Turn the tilt platform over and remove the 4 screws (2.5mm hex key) that secure the tilt assembly cover.

5. Remove the two plastic inserts. The long insert holds a positioning spring and the smaller ball insert holds the screw ball in position.

6 Press back the brake lever to provide access to the brake pad, then use pliers or a thin 14mm open end wrench to remove the nut to which the brake pad is fastened. Replace the brake pad assembly.

5.6 Castor Replacement (Figure 5-7)

The castors may be replaced with the unit upright or carefully placed on its back.

1. Lock all the other castors.

2. Lift the castor off the floor and use blocks to support the leg near the castor you are replacing.

3. Remove the screw on the side of the leg that holds the castor in its mounting hole. Remove the castor.

4. Line up the hole in the castor stem with the set screw hole in the leg and insert the castor. As you tighten the screw the castor should be drawn into the leg.

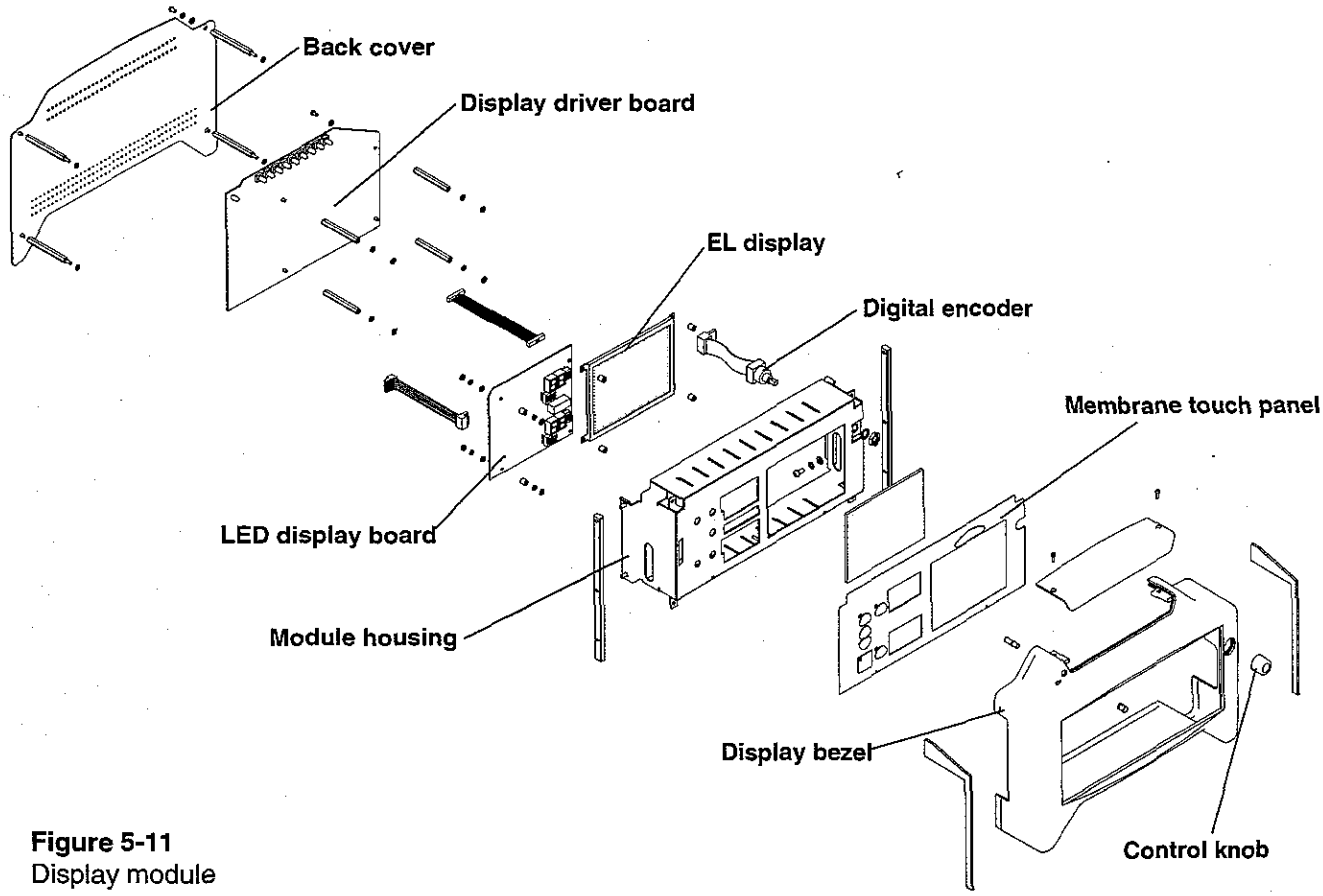


Figure 5-11
Display module

5.7 Controller and Display Module Procedures

5.71 Display module (Figure 5-11)

1. Using a 2mm hex key, remove the 4 button head socket screws and lock washers that secure the back cover to the display module and remove the panel.

2. To remove the display driver board, first remove the 4 screws the hold the board to the standoffs, then disconnect the electrical connectors.

3. To replace the digital encoder for the EL display, pull the control knob off the shaft, disconnect the electrical connector, remove the nut that secures the encoder, and remove the encoder.

4. To remove the LED display board, disconnect the electrical connectors, then remove the 2 standoffs (6mm wrench) that hold the board in place, and then the 2 nuts with hardware.

5. To remove the EL display, disconnect the electrical connectors, then remove the 2 nuts that hold the display in place. Be careful not to get finger prints on the display and be sure it is clean before replacing it.

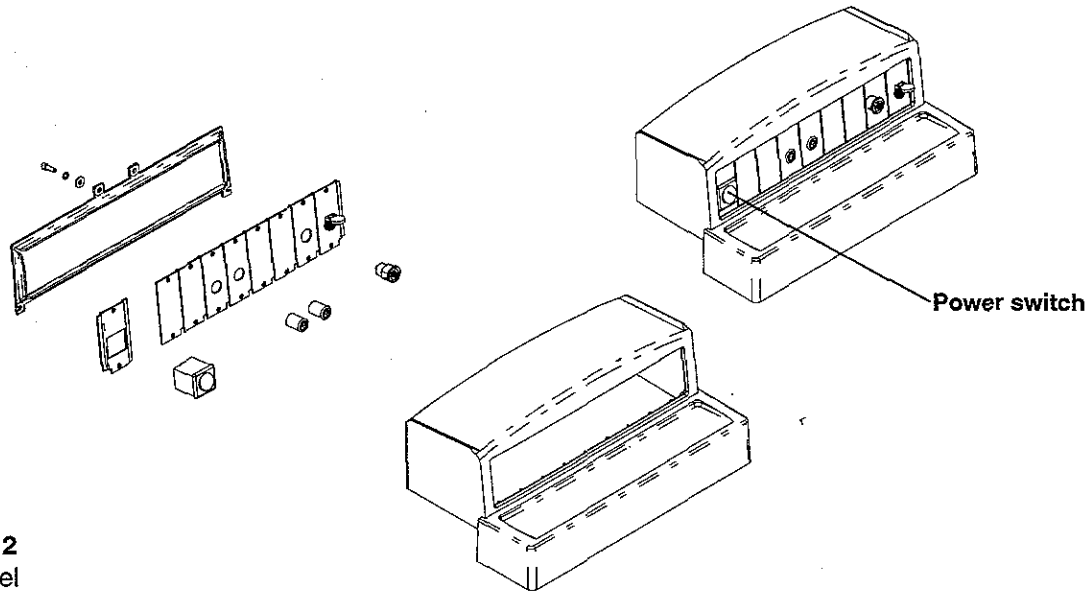


Figure 5-12
Probe panel

6. The standoffs that hold the back cover also secure the bezel to the front of the module housing. Remove the standoffs (6mm wrench) and remove the bezel. To replace the membrane switch panel, first disconnect its electrical connector and then peel it off the display module housing. Be careful to remove all residue adhesive from the module before installing a new membrane panel. The membrane panel can not be repositioned once it has been applied without damaging it.

5.72 Probe panel (Figure 5-12 and 6-28)

1. Using a 2.5 mm hex key, loosen the 2 screws in the keyhole slots and remove the 6 remaining screws that secure the controller cover, then remove the cover. Disconnect the wire harnesses coming from the probe panel.

2. Remove the 2 screws at the bottom corners that hold the probe panel to the enclosure.

3. Remove the probe panel assembly.

4. While tilting the panel enclosure forward, use a 3mm hex key to remove the 4 screws that hold the panel frame in place. Add new jacks through the panel frame as appropriate.

   Note: The power switch panel must be on the far left. The position of the remaining panels is not critical.

5.73 Controller Components (Figure 5-13)

Using a 2.5 mm hex key, loosen the 2 screws in the keyhole slots and remove the 6 remaining screws that secure the controller cover, then remove the cover. Now you can access the electrical components listed below.

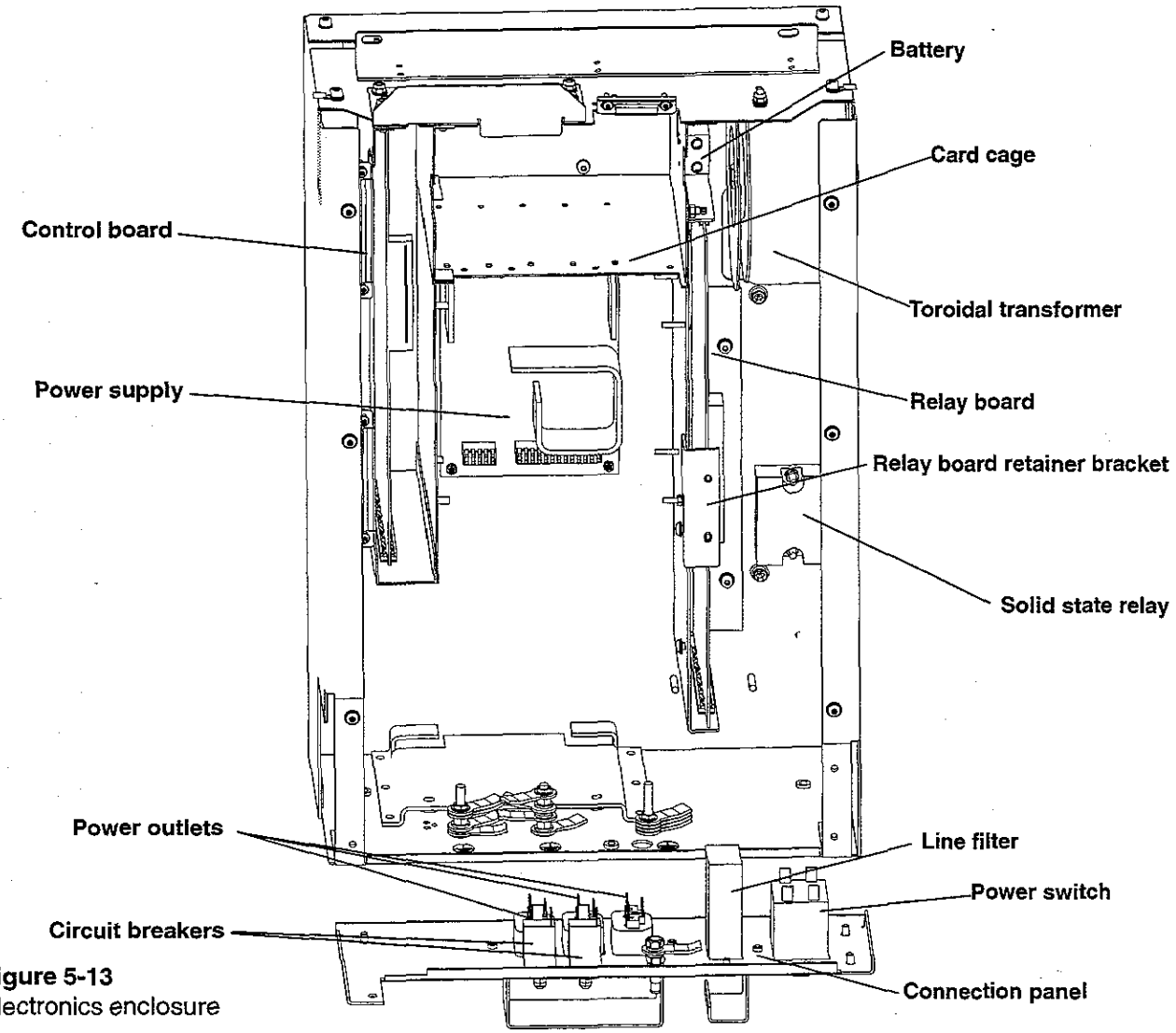


Figure 5-13
Electronics enclosure

Control Board

Slide the control board out about an inch and disconnect all the electrical connectors along its outside edge, then remove the board.

Dipswitch configeration on replacement control boards:

Switch 1 must be ON
Switch 2 must be OFF
Switch 3 must be ON if servo humidifier is installed
Switches 4,5, 6 and 7 are unused and should be OFF
Switch 8 must be OFF

Note: Always perform System Calibration and Humidifier calibration after replacing the control board.

Relay Board

Remove the two M3 hex nuts that secure the relay board retainer bracket with a 5.5 mm socket, then pull the board out a little and disconnect the electrical connectors on the outer edge. Then pull it out a little more and disconnect the connectors at the bottom end of the board. Now the board can be pulled out the rest of the way so the back connectors can be disconnected. You can now access the 2 fuses on the board.

Note: Always perform Line Voltage Calibration after replacing the relay board.

Solid State Relay

To replace the solid state relay, disconnect the electrical connections, and using a 7mm wrench remove the 2 nuts that secure it to the enclosure.

Power Supply

To access the power supply, disconnect the 50 pin ribbon cable that crosses in front of it. To remove the power supply, use a 5.5mm wrench to remove the nuts that secure it.
After installing the replacement power supply perform the following tests:

To verify the power supply outputs are correct measure the following voltages on one of the unused connectors that feed power to the option boards. The voltages are not adjustable. If they are out of specification the power supply must be replaced.

Signal	Measure at	Acceptable Range
5 Volts	Pins 2 to 1	4.75 volts to 5.25 volts
12 volts	Pins 3 to 1	10.80 volts to 13.20 volt

Battery

The battery snaps into a holder on the side of the card cage. It has two snap connectors at its top. When replacing the battery, its easier to first connect the terminals then push the battery into its holder.

Toroidal transformer

To replace the elevating base toroidal transformer, it may easier to first remove the entire card cage. To remove the card cage first remove probe panel so you can access the 4 screws on the top wall of the cage. Then remove the relay board to access the 2 screws on the right edge of the cage that secure it to the back wall of the electrical enclosure. Take out the last 3 screws in the middle that secure the cage to the back wall of the electrical enclosure and remove the cage. Now you can access the toroidal transformer.

Circuit breakers, Power switches and Power outlets

The circuit breakers, power switches and power outlets can all be more easily accessed by removing the connection panel at the bottom of the enclosure by removing the 3 screws that secure it with a 2.5 mm hex key.